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POTENTIAL SUPPLY OF NATURAL GAS IN THE UNITED STATES

(as of December 31, 1982)

Report of the Potential Gas Committee
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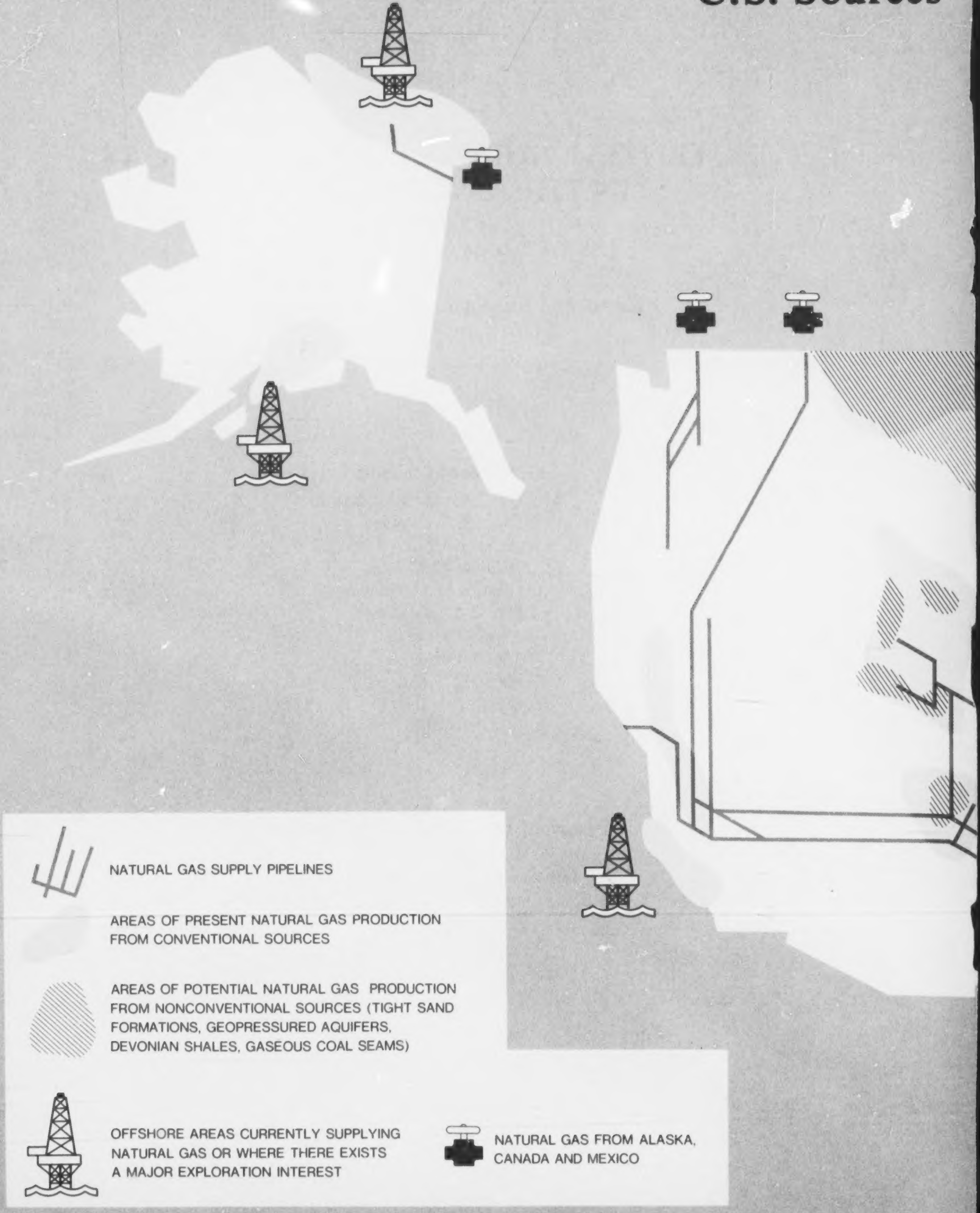
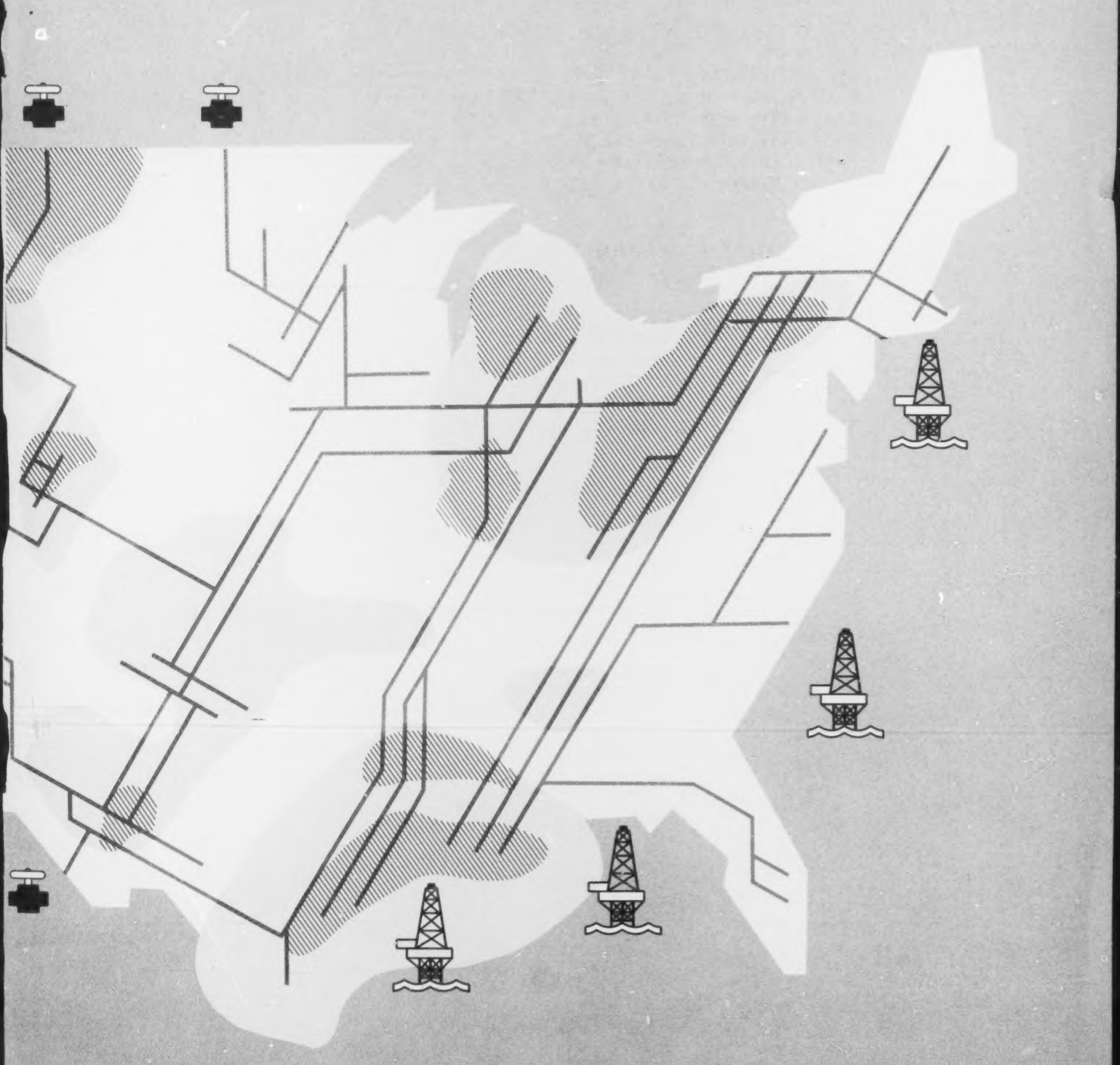
Colorado School of Mines

June 1983

U.S. Sources


NATURAL GAS SUPPLY PIPELINES
AREAS OF PRESENT NATURAL GAS PRODUCTION FROM CONVENTIONAL SOURCES
AREAS OF POTENTIAL NATURAL GAS PRODUCTION FROM NONCONVENTIONAL SOURCES (TIGHT SAND FORMATIONS, GEOPRESSURED AQUIFERS, DEVONIAN SHALES, GASEOUS COAL SEAMS)
OFFSHORE AREAS CURRENTLY SUPPLYING NATURAL GAS OR WHERE THERE EXISTS A MAJOR EXPLORATION INTEREST
NATURAL GAS FROM ALASKA, CANADA AND MEXICO

Of Conventional And Nonconventional Gas and the Natural Gas Transmission System



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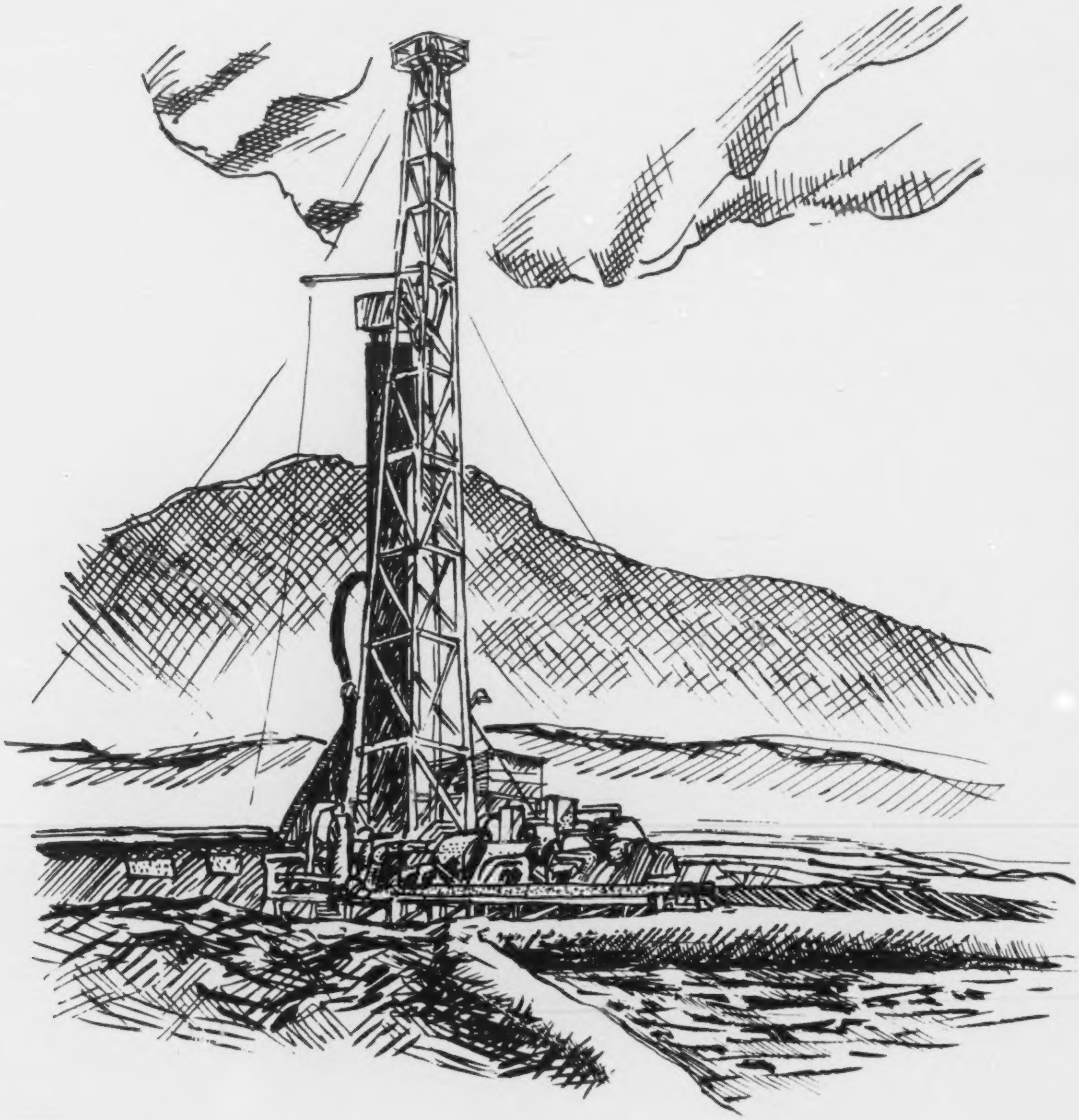
PART I

REPORT OF THE POTENTIAL GAS COMMITTEE



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REPORT OF THE POTENTIAL GAS COMMITTEE

Summary

The Potential Gas Committee comprises volunteer members from the natural gas industry, government agencies, and academic institutions who are concerned with natural gas resources. Members of the Committee, their experience and affiliations, are listed in Part III of this report. The Committee functions independently but with the guidance and assistance of the Potential Gas Agency of the Colorado School of Mines. The Potential Gas Agency is supported by the American Gas Association. Biennial estimates of the potential supply of natural gas have been prepared and published since 1966, with the exception of 1974.

The Potential Gas Committee's estimate of the potential supply of natural gas in the United States, as of December 31, 1982, is as follows:

Table 1 — Estimated potential supply of natural gas (trillions of cubic feet at 14.73 psia and 60° F.)

	Probable	Possible	Speculative
Lower 48 States			
—Onshore	151	263	179
—Offshore	33	63	53
Alaska			
—Onshore	6	16	28
—Offshore	2	13	69
Total United States	192	355	329

The sum of these estimates represents a total resource potential of 876 trillion cubic feet (Tcf).

The foregoing estimates represent the conventional potential supply expected to be recovered by future drilling under conditions of:

1. adequate economic incentives in terms of price/cost relationships, and
2. current or foreseeable technology.

These estimates do not assume any fixed time schedule for the discovery and production of future gas supply.

The Potential Gas Committee's estimates do not include, and are distinct and separate from, the volume of proved recoverable natural gas reserves estimated by the Committee on Natural Gas Reserves of the American Gas Association through 1979 and by the Office of the Oil and Gas Information System, Energy Information Administration, U.S. Department of Energy, since 1977. The relationship betwen proved reserves and the several categories of potential natural gas supply is illustrated in figures 2 and 3, and described in detail in the section entitled "Categories of Natural Gas Resources."

The Potential Gas Committee's previously published estimates of each category, as of December 31, 1980, of the potential supply of natural gas in the United States were as follows (trillions of cubic feet): Probable 193, Possible 358, and Speculative 362.

Comparison of these totals with the new estimates presented in table 1 reveals little change in the Probable and Possible categories and a decrease of 33 trillion cubic feet in the Speculative category. These estimates, however, represent the current status of a dynamic system in which former potential resources pass into proved reserves and production through discovery and development of new pools and fields and the estimates of remaining potential resources are revised based on knowledge gained through additional exploration and drilling.

Frontier areas, such as some offshore regions, Alaska, and portions of the Rocky Mountain states, tend to have major changes in resource estimates from report to report, especially in the Speculative category. These changes reflect the uncertainty of resource estimation where available geological and geophysical data are limited and where new exploration programs may bring about significant changes in the knowledge and interpretation of the nature and occurrence of the natural gas resource.

The current estimate for the Rocky Mountain states (Area H) has been increased over 1980 largely because of the inclusion of large quantities of low-heat-content gas in western Wyoming and of potential now believed to exist in some areas in central Wyoming where gas-bearing sedimentary rocks are now known to occur beneath major thrust faults. It is now believed that the low-heat-content gas can be commercially developed and that the sub-thrust sedimentary rocks provide additional targets for exploration.

The estimate of potential for the Mid-Continent area (Area J-North), particularly Oklahoma, was decreased due to transfers from potential resources to proved reserves and to better evaluation of the potential made possible by recent high levels of drilling activity. This activity confirmed some estimates made previously but there have been disappointments also in some areas such as the deep Pennsylvanian Springer sands in the southeastern part of the Anadarko basin. The estimate for California, Oregon, Washington and Nevada (Area L) has been reduced primarily because of a re-evaluation of the potential for the deep portion of the San Joaquin basin plus transfers to proved reserves. Recent exploration activity has diminished what had been considered to be prospective acreage and potential resources in Alaska (Area K), for example, portions of the Arctic basin, the Gulf of Alaska, the Lower Cook Inlet, the Kodiak and Yakataga areas and the Bering Sea.

Estimates for the other areas of the country show no significant changes other than those expected by normal developments. These include the relatively mature exploration and production areas of Texas (Areas D, G, and J-South) and Louisiana (Area E) which have shown consistent declines in estimates of potential gas resources as their gas resources have been discovered and developed.

Introduction

The objective of the Potential Gas Committee is to provide estimates, based upon expert knowledge, of the potential supply of natural gas which, in conjunction with estimates of proved reserves of natural gas, make possible an appraisal of long-range gas supply.

For many years, estimates of future supply of natural gas have been developed by numerous individuals and organizations. Since these estimates of future supply have varied widely and often have had entirely different objectives and meanings, they have served to confuse rather than to clarify the long-range outlook for natural gas supply. With the view to achieving a more unified industry-sponsored effort, many of the leaders of the natural gas industry, as well as various financial and governmental agencies, expressed a strong desire for a continuous long-range study of the requirements and supply of natural gas in the United States. As a result of this concern, the work of the Potential Gas Committee was initiated in 1960. The Committee has continued to function since that time and has prepared regular reports presenting estimates of the recoverable natural gas which is believed to exist in addition to that amount included in proved reserves. Since 1967 the work of the Committee has been guided and assisted by the Potential Gas Agency of the Colorado School of Mines.

Annual estimates of proved reserves of natural gas in the United States were prepared, through 1979, by the Committee on Natural Gas Reserves of the American Gas Association. Since 1977, and continuing to the present, annual estimates of proved reserves have been prepared independently by the Energy Information Administration of the U.S. Department of Energy. These estimates are, by definition, limited to those estimated proved recoverable reserves of natural gas which have been established by drilling. Such estimates do not reflect potential supplies of natural gas which may be discovered as a result of future exploratory drilling. It is the estimates of future supply which are the concern of the Potential Gas Committee and which are discussed in this report.

The estimates of the Potential Gas Committee include recoverable "conventional" natural gas which, in the judgment of Committee members, can be recovered given adequate economic incentives in terms of price/cost relationships and utilizing current or foreseeable technology. Since these potential resources have not yet been confirmed by drilling and testing, there can be no rigorous evaluation of the economic viability of the resources, but the accumulations are believed to exist in concentrations which are of sufficient size and quality, considering geographic distribution and depth of occurrence, to warrant exploration and development.

Previous volumes (1978 and 1980) have included summaries, prepared by the Potential Gas Agency, of estimates of potential resources of natural gas which may exist under nonconventional conditions, including gas from tight formations, Devonian shales, geopressured brines, coal beds, and gas hydrates. A similar summary is not included with this report and the reader is referred to the previous publications for such information.

Review of the estimates of the Potential Gas Committee has indicated that a portion of the natural gas resource estimated by the Committee is believed to occur in formations which have **in situ** permeabilities to natural gas of less than 0.1 millidarcy. Such resources have been included by others in estimates of nonconventional resources and, consequently, there is partial overlap with estimates of the Potential Gas Committee. The magnitude of this overlap is addressed in the reports of the Area Work Committees included in this volume.

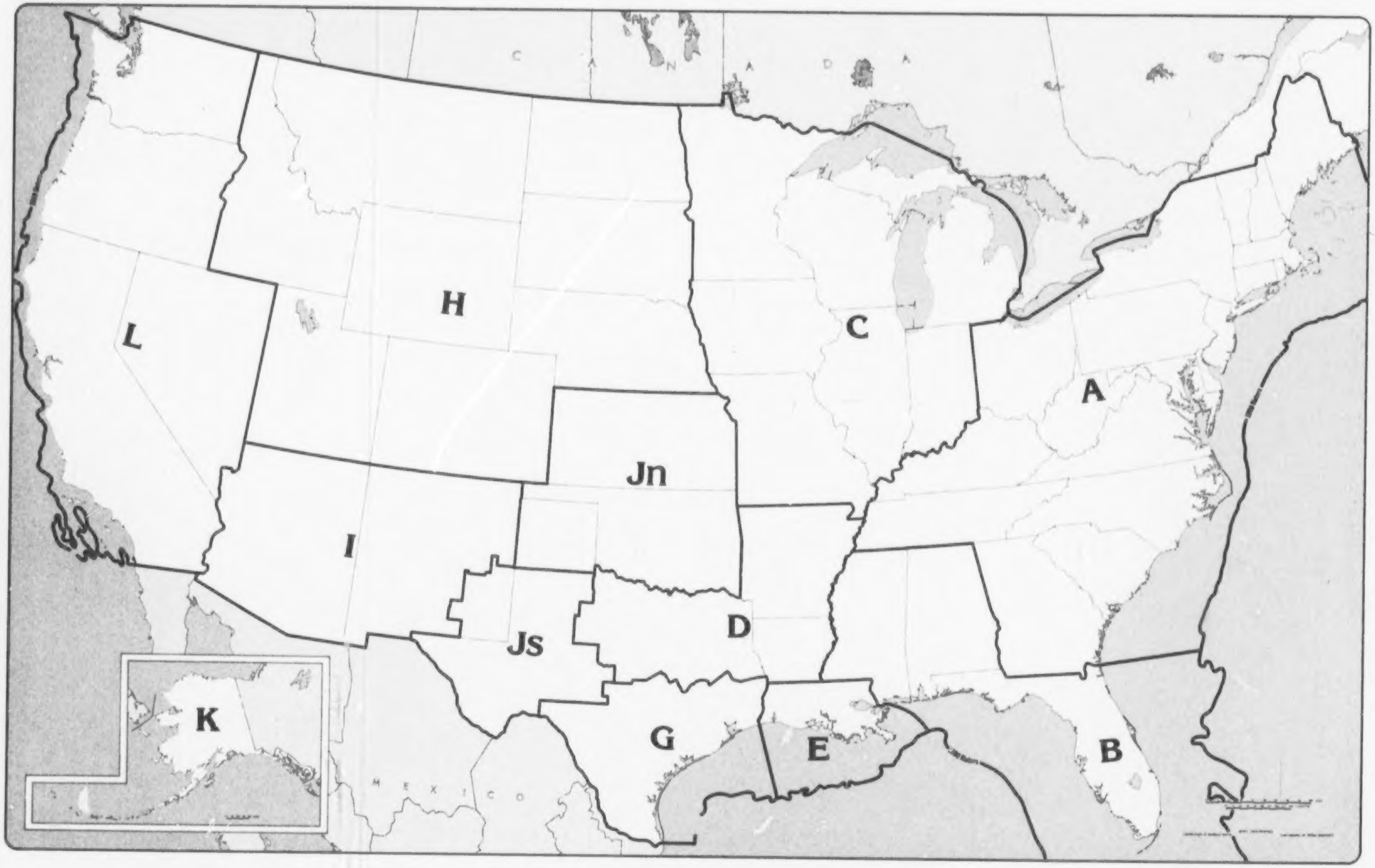

Figure 1 — Reporting areas—Potential Gas Committee

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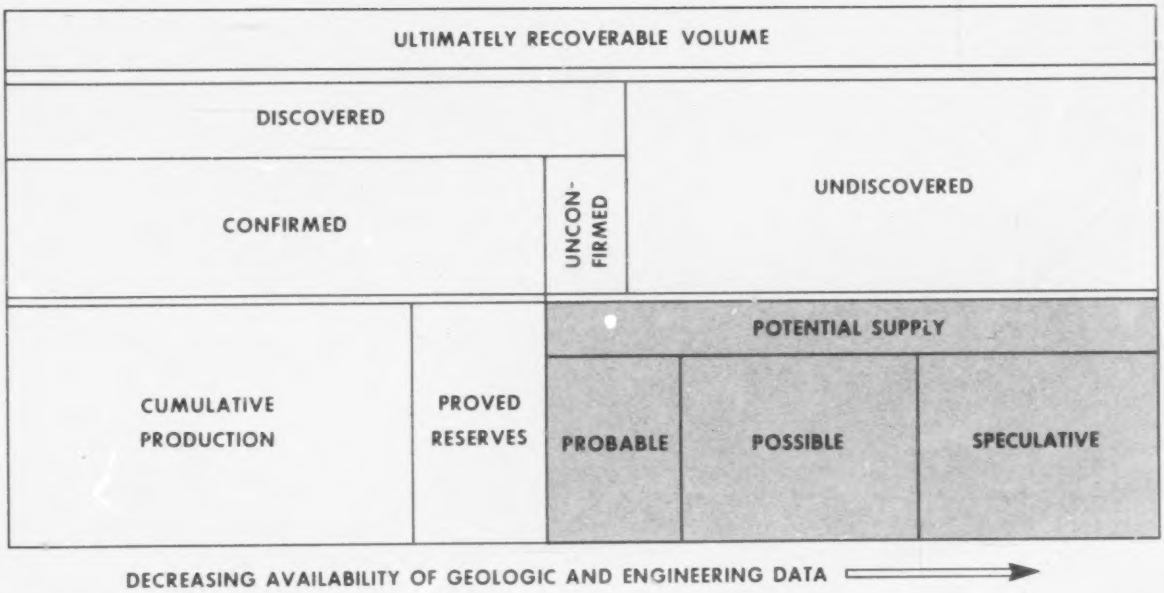

Figure 2 — Categories of past, present and future natural gas supplies

Categories of Natural Gas Resources

The estimates of potential supply of natural gas presented in this report can be used responsibly only with a thorough understanding of how they are defined and what they represent. An overlying constraint on estimating the amount of any natural resource is what is known about it. Unlike some other resources, natural gas is unseen and very diffuse. Accumulations are found in porous rocks buried beneath the surface of the earth in a wide variety of structural and stratigraphic traps. Such characteristics make precise estimates difficult to calculate without a large amount of data. Since the data base is never as complete as one may wish, estimates are dependent upon the professional judgment of the estimator and his continuing analysis as new data become available.

In order to be able to report reliable and meaningful estimates, the Potential Gas Committee has adopted a number of supply or resource categories. To ensure credibility, the categories are established on the basis of specific criteria. Much of what is known about natural gas accumulation is based on geological principles. It is, therefore, reasonable to utilize this type of knowledge and the availability of this knowledge as a basis for defining specific categories. The categories of natural gas resources used by the Potential Gas Committee are shown in figure 2 and are defined and discussed in the following section. A schematic representation of the various categories of potential supply is illustrated in figure 3.

Explanation for Figure 3 — Schematic representation of categories of potential supply

I Probable — Associated with existing fields — most assured,
  1) Discovered: discovered trap, existing production [1]
  2) Undiscovered: undiscovered trap, productive formation — supply from new pool discoveries within existing fields in
    a) reservoir producing within the same field [2]
    b) shallower or deeper formations producing elsewhere within same geologic province or subprovince [3]

II Possible — Associated with productive formations — less assured,
  1) Similar geologic conditions [4]
  2) Different geologic conditions: e.g., stratigraphic vs. structural trap [5]

III Speculative — Most nebulous
  1) From nonproductive formations in productive province
    a) new pool [6]
    b) new field [7]
  2) From nonproductive province [8]

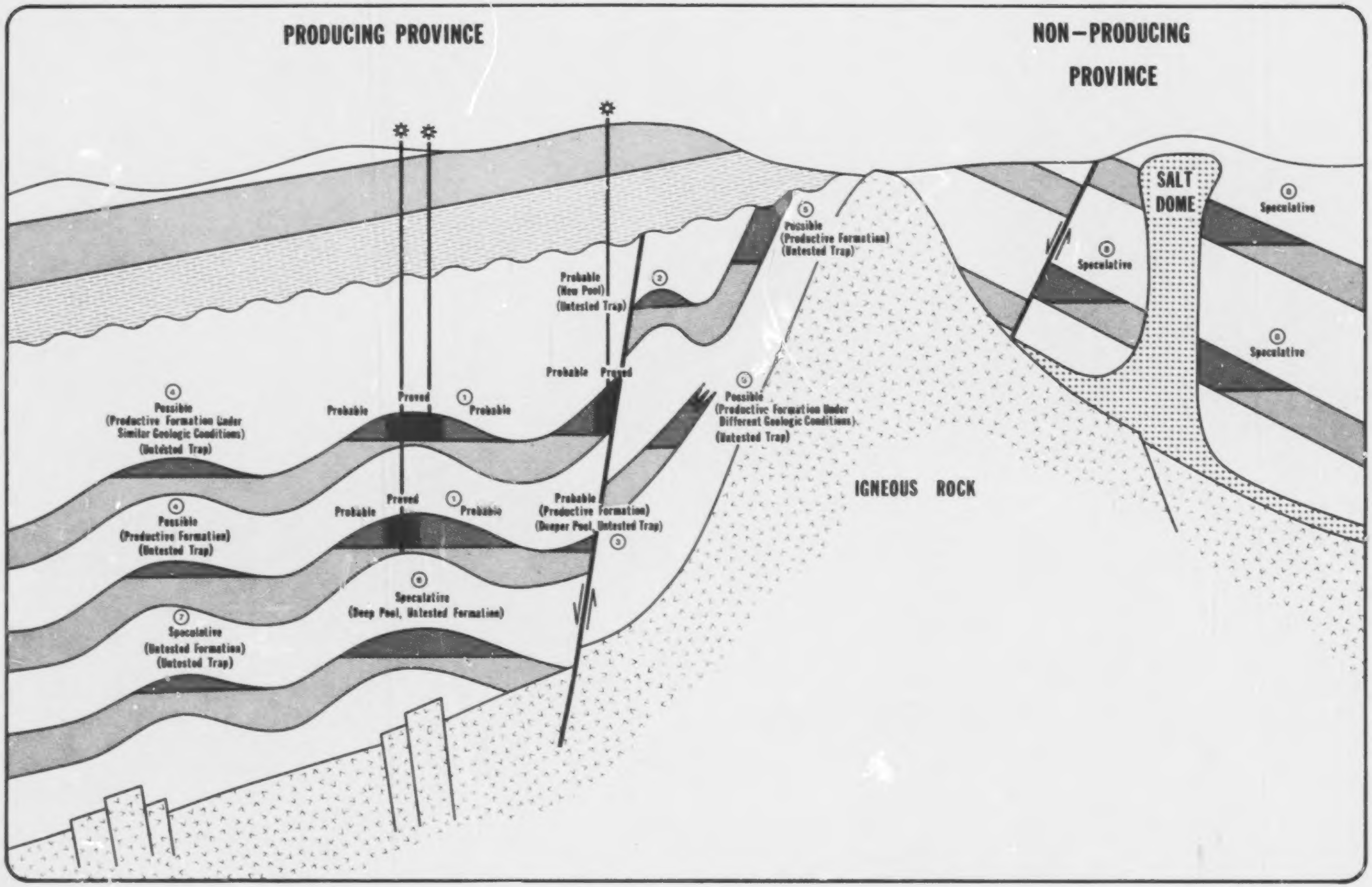
PRODUCING PROVINCE
NON-PRODUCING PROVINCE
④ Possible (Productive Formation Under Similar Geologic Conditions) (Untested Trap)
Probable
Proved
① Probable
Probable (New Pool) (Untested Trap)
②
Probable
Proved
⑤ Possible (Productive Formation) (Untested Trap)
⑤ Possible (Productive Formation Under Different Geologic Conditions). (Untested Trap)
④ Possible (Productive Formation) (Untested Trap)
Probable
Proved
① Probable
Probable (Productive Formation) (Deeper Pool, Untested Trap)
③
⑥ Speculative (Deep Pool, Untested Formation)
⑦ Speculative (Untested Formation) (Untested Trap)
IGNEOUS ROCK
SALT DOME
⑧ Speculative
⑧ Speculative
⑧ Speculative

Figure 3 — Schematic representation of categories of potential supply

DEFINITION OF NATURAL GAS

Natural gas, as used in this report, is any gas (at standard conditions of temperature and pressure) of natural origin that is composed primarily of hydrocarbon molecules producible from a borehole. Most natural gas contains some nonhydrocarbon components such as carbon dioxide, nitrogen, hydrogen sulfide, helium, etc. In estimating potential supply, it is not feasible to separate small volumes of these components from the hydrocarbons; however, in areas where significant volumes of such nonhydrocarbons are believed to occur, only the hydrocarbon components are included in the estimated potential supply.

NATURAL GAS RESOURCES

At a given time a finite volume of natural gas in-place exists within the rocks of the shallow portion of the earth's crust. This finite volume of gas in-place is the total natural gas resource. The amount of this resource which is recoverable is a function of technology and economics. Today, technology has advanced to the degree that a significant part of the resource base can be recovered. A major part of this resource, however, is dispersed throughout the earth's crust in such minute accumulations or under such conditions that it cannot be extracted with existing or foreseeable technology, and also because the cost of recovery of this gas is too high compared to the value of the gas. Even with likely advances in technology, production of some deposits will not be feasible because recovery of such accumulations would require more energy than that provided by the gas produced.

Estimates of the Potential Gas Committee include only the natural gas resource which can be discovered and produced using current or foreseeable technology and under the condition that the price/cost ratio will be favorable. This total quantity is referred to as the *Ultimately Recoverable Volume.* Terminology used in this report emphasizes that the Committee is presenting estimates of natural gas which they believe can be both *discovered* and *recovered* under the limiting conditions established by the Committee.

The *Ultimately Recoverable Volume* represents the quantity of natural gas expected to be produced during the life of the industry through exploration and development of the resource. Recovery would be effected by utilizing conventional techniques of exploration, drilling, completion and production and also by incorporating new technological developments. The Ultimately Recoverable Volume is composed of both the *discovered* and the *undiscovered* natural gas resources. Discovered gas consists of the quantity which has been produced in past years plus that which has been proved by drilling and engineering tests and is included in present *Proved Reserves.* Additionally, discovered gas includes the gas, remaining in known fields, which will be recovered through extension and complete development of known pools and reservoirs. The undiscovered resource consists of the potential gas supply which is expected to become productive upon further exploration and development and includes both the gas remaining in undiscovered pools and reservoirs within known fields and the gas which may be discovered in new fields and reservoirs within provinces which are presently productive and within provinces which are as yet unproductive.

The subdivision of Ultimately Recoverable Volume into categories reflects the variation in the amount of geological and engineering information upon which the estimate is based. Proceeding from left to right in figure 2, the level of geological and engineering knowledge decreases.

Past production is reported as cumulative production and is the total volume of natural gas withdrawn from producing reservoirs. Some uncertainty involving the amount of production from earlier years exists as a result of incomplete records, but a reasonable estimate has been made based on available information. Estimates of past production presented in this report have been prepared by the Committee on Natural Gas Reserves of the American Gas Association.

Proved reserves are the currently estimated quantity of natural gas which analysis of geologic and engineering data demonstrate with reasonable certainty to be recoverable in the future from known oil and gas reservoirs under existing economic and operating conditions. Reservoirs are considered proved that have demonstrated the ability to produce by either actual production or conclusive formation tests. The existence and quantity of gas have been *confirmed* by testing. The Potential Gas Committee does not estimate volumes of proved reserves. Estimates of proved reserves were compiled annually from 1946 through 1979 by the Committee on Natural Gas Reserves of the American Gas Association (AGA). The AGA estimates have been largely supplanted by reports prepared by the Energy Information Administration of the U.S. Department of Energy (EIA). EIA reports of U.S. proved reserves began with data for 1977 and have replaced the AGA estimates for 1980 and subsequent years.

The *Potential* supply includes the remaining portion of discovered gas resource in addition to proved reserves and all of the undiscovered resource. Three categories of potential supply are recognized and reported by the

POTENTIAL GAS COMMITTEE	PROBABLE	POSSIBLE	SPECULATIVE
UNITED STATES GEOLOGICAL SURVEY RESOURCE APPRAISAL GROUP	INFERRED RESERVES	UNDISCOVERED RECOVERABLE RESOURCES	

Figure 4 — Comparison of Potential Gas Committee and U.S. Geological Survey natural gas resource classification categories

Potential Gas Committee: Probable, Possible and Speculative. These three categories are differentiated on the basis of variation in available geologic information. The reported figures are the estimate of the most likely amount of natural gas (i.e., modal value) that can be expected to be found and recovered in each category.

Probable potential gas supply is associated with existing fields. It is the most assured of potential supplies because it is associated with known accumulations and a relatively large amount of geological and engineering information is available to aid in estimation of the reported figures in this category. The Probable supply bridges the boundary between discovered and undiscovered resources. The discovered portion includes supply from future extensions of *existing pools* in known productive reservoirs [1].* The pool containing this gas has been discovered, but the extent of the pool has not been completely delineated by development drilling; therefore, the existence and quantity of gas in the undrilled portion of the pool are as yet *unconfirmed*. The undiscovered portion of Probable supply is expected to come from future *new pool* discoveries within existing fields either in reservoirs productive elsewhere in the field [2], or in shallower or deeper formations known to be productive elsewhere in the same geologic province or subprovince [3].

Possible potential supply is a less assured supply because it is postulated to exist outside of known fields, but it is associated with a productive formation in a productive province. Its occurrence is indicated by projection of plays or trends of a producing formation into a less-well-explored area of the same geologic province or subprovince. Supply is from *new field* discoveries, postulated to occur within these trends or plays under both similar [4] and different [5] geologic conditions (i.e., the types of traps and/or structural settings may either be the same or differ in some aspect).

Speculative potential gas supply is the most nebulous category. This potential supply is from formations or provinces which have not yet proven to be productive. Geologic analogs are developed in order to ensure reasonable evaluation of these unknown quantities. Supply is from *new pool* [6] or *new field* [7] discoveries in *formations not previously productive* within a productive geologic province or subprovince and also *new field* discoveries within a geologic *province not previously productive* [8].

To reiterate, the accuracy of the estimates of gas volumes included in the potential supply is dependent upon geological conditions and knowledge and the extent to which the given area has been explored and developed. By following the estimation guidelines as closely as possible, consistency and compatibility of the estimates by members of the Potential Gas Committee are maintained. However, the individual estimator may have to use slight modifications of the considerations and procedures when compiling estimates for each of the three categories because of the particular characteristics applicable to his reporting area.

Estimates of potential resources of natural gas in the United States are also made by the Resource Appraisal Group of the United States Geological Survey. Their most recent published report is contained in U.S.G.S. Circular 860[1] and includes estimates of crude oil and natural gas liquids as well as natural gas. Although resource terminology of the U.S.G.S. Resource Appraisal Group differs from that used by the Potential Gas Committee, the U.S.G.S. category Inferred Reserves is essentially equivalent to Probable resources, and the U.S.G.S. category Undiscovered Recoverable Resources is essentially equivalent to the combined Possible and Speculative categories (fig. 4). A further discussion of the definitions and usage of U.S.G.S. terminology is set forth in U.S.G.S. Circular 831.[2]

---

*Numbers in brackets refer to accumulations shown diagrammatically in figure 3.

[1] Dolton, G. L. and others, 1981, Estimates of undiscovered recoverable conventional resources of oil and gas in the United States: U.S. Geological Survey Circ. 860, 87 p.

[2] U.S. Bureau of Mines and the U.S. Geological Survey, 1980, Principles of a resource/reserve classification for minerals: U.S. Geological Survey Circ. 831, 5 p.

Estimation of Potential Gas Supply

TECHNIQUES FOR ESTIMATION OF POTENTIAL GAS SUPPLY

A basic technique for estimating potential gas supply is applied to each of the categories adopted by the Potential Gas Commitee. In each case, what is known about the prospective area is evaluated relative to what is known about natural gas accumulations and the factors known to control their occurrence. Studies of producing areas have provided information on the productive capacity of particular formations and the average size of accumulations. Natural gas occurrences are related to conditions which favor their formation and accumulation, such as the existence of source rocks, sufficient maturation of organic material, and presence of reservoir rocks and traps. Modification of the basic technique is necessary to accomodate the variations in amount of information available for prospective areas. In the most simplified form, the potential supply is derived by: (1) estimating the volume of potential gas-bearing reservoir rock, (2) multiplying this quantity by a yield factor,* and (3) discounting to allow for the probability that the traps and/or the accumulations exist. Figures 5-8 illustrate the modifications applied to this procedure for the different categories.

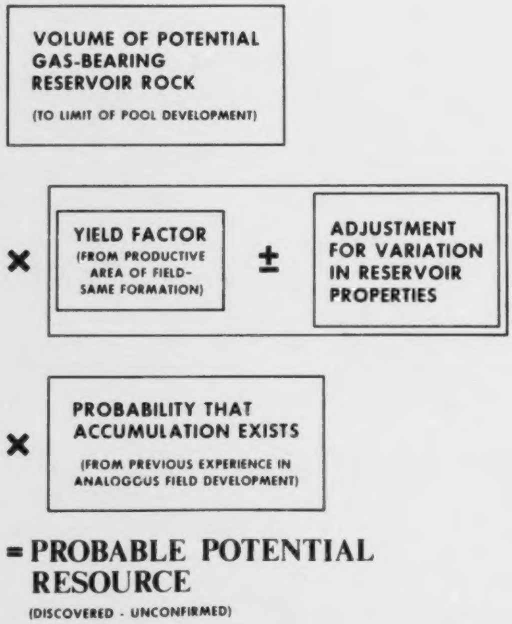
VOLUME OF POTENTIAL GAS-BEARING RESERVOIR ROCK
(TO LIMIT OF POOL DEVELOPMENT)
×
YIELD FACTOR
(FROM PRODUCTIVE AREA OF FIELD-SAME FORMATION)
±
ADJUSTMENT FOR VARIATION IN RESERVOIR PROPERTIES
×
PROBABILITY THAT ACCUMULATION EXISTS
(FROM PREVIOUS EXPERIENCE IN ANALOGOUS FIELD DEVELOPMENT)
= PROBABLE POTENTIAL RESOURCE
(DISCOVERED - UNCONFIRMED)

Figure 5 — Schematic diagram of procedure for estimation of discovered — unconfirmed Probable potential supply

Probable potential supplies bridge the division between discovered and undiscovered resources. The discovered portion includes extensions of accumulations which are estimated to be partially developed. The undiscovered portion is composed of new pools which may be discovered within an existing field. In the case of *discovered*, but *unconfirmed, Probable* potential (fig. 5), the volume of potential rock is calculated to the limits of pool development based on geological, geophysical and engineering data. The estimated volume is multiplied by a yield factor obtained from the area of the field which is presently producing from the same formation as the extension being evaluated and which is adjusted for such possible variations as changes in lithology, thickness, porosity, permeability, hydrodynamic conditions or gas/oil/water relationships in the reservoir. To arrive at a *Probable* potential resource estimate, the product of the reservoir volume and the yield factor is then multiplied by the probability that the accumulation actually exists. This probability is determined by the estimator based on previous experience in development of similar fields in the province.

Estimating *undiscovered Probable* potential supply (fig. 6) involves more geological and geophysical interpretation in order to delineate all possible new pools within existing fields. The volume of potential gas-bearing reservoir rock is calculated for known and untested traps (as in the case of suspected multizone development of an anticlinal trap) and potential but unknown traps (pools separated from current production by faults or facies changes, such as overlapping barrier bars). This calculated volume is adjusted for possible changes in lithology and reservoir characteristics as well as variations in thickness and lateral extent

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*Yield factors represent the amount of gas expected to be produced from a given unit of rock. They are calculated using data from known gas accumulations considered to be most similar to the one being evaluated. The yield is the volume of discovered gas (i.e., cumulative production plus proved reserves) divided by the volume of productive rock.

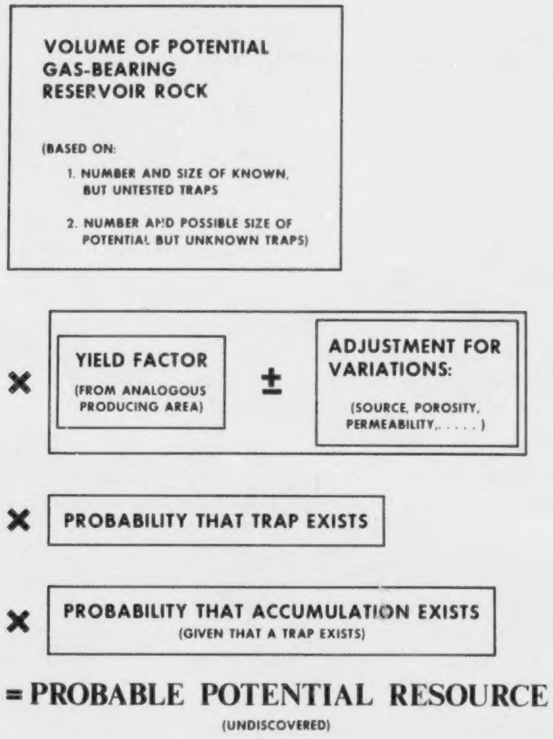
VOLUME OF POTENTIAL GAS-BEARING RESERVOIR ROCK
(BASED ON:
1. NUMBER AND SIZE OF KNOWN, BUT UNTESTED TRAPS
2. NUMBER AND POSSIBLE SIZE OF POTENTIAL BUT UNKNOWN TRAPS)
×
YIELD FACTOR
(FROM ANALOGOUS PRODUCING AREA)
±
ADJUSTMENT FOR VARIATIONS:
(SOURCE, POROSITY, PERMEABILITY, ...)
×
PROBABILITY THAT TRAP EXISTS
×
PROBABILITY THAT ACCUMULATION EXISTS
(GIVEN THAT A TRAP EXISTS)
= PROBABLE POTENTIAL RESOURCE
(UNDISCOVERED)

Figure 6 — Schematic diagram of procedure for estimation of undiscovered Probable potential supply

of the reservoir. Variations of this type might include lateral changes in the bedding such as sand pinchouts or facies changes. Proper evaluation requires a familiarity with both the nature of the formation within the province and also the local facies and structural setting. The estimated volume is multiplied by an adjusted yield factor which is obtained by analogy with a producing area similar to the potential new pool under consideration. The yield factor is adjusted to account for any differences thought to exist between the analog and the potential reservoir. These differences may include factors such as different porosities and permeabilities due to deposition within different energy regimes or to diagenetic changes resulting from different depths of burial. Presence and quality of source rocks and their maturation levels must also be considered. The amount of potential supply thus calculated must then be discounted by two factors. The first discount factor is a measure of how certain the estimator is of the existence of the traps. In the case of potential multizone anticlines, the traps are known to exist and there is no discount. It is more difficult to assess the probability of occurrence of unknown traps and a thorough understanding of the geology is important in order to make a competent evaluation. The second discount factor considers the possibility that even though all conditions are favorable for an accumulation, including the existence of a trap, gas may not actually have accumulated. For instance, the trap may not have existed at the time of migration of the gas. With inclusion of these two discount factors, an estimate of the *undiscovered Probable* potential resource can be made.

The technique for estimating *Possible* potential supply (fig. 7) is essentially the same as for the undiscovered Probable category. Both situations involve untested traps within formations productive within the province but differ in their association with proved production. Possible supplies are located within a productive province, but away from presently productive fields. For this reason it is necessary to consider the possible existence of producing trends or plays. By extending a trend or a play from a productive area into a relatively unexplored area, a reasonable geologic interpretation can be made about the number and types of traps to be found in that region. Available geophysical or geological data may also indicate the location and possible size of potential traps. Careful evaluation of the trend or play is

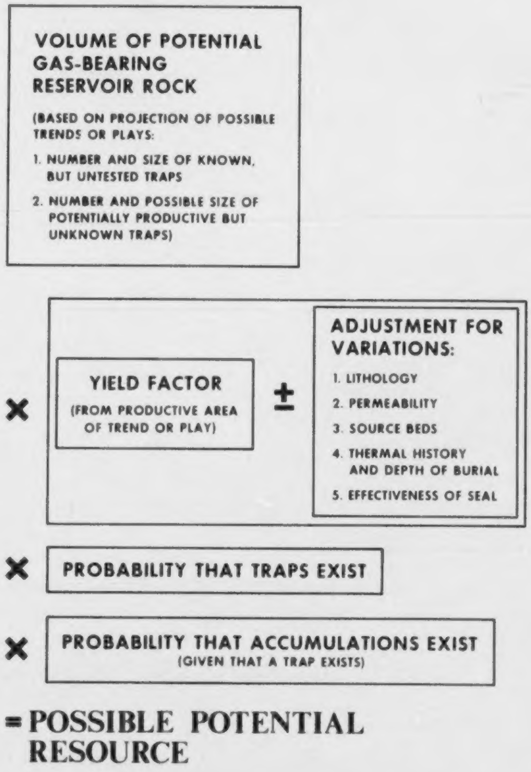
VOLUME OF POTENTIAL GAS-BEARING RESERVOIR ROCK
(BASED ON PROJECTION OF POSSIBLE TRENDS OR PLAYS:
1. NUMBER AND SIZE OF KNOWN, BUT UNTESTED TRAPS
2. NUMBER AND POSSIBLE SIZE OF POTENTIALLY PRODUCTIVE BUT UNKNOWN TRAPS)
×
YIELD FACTOR
(FROM PRODUCTIVE AREA OF TREND OR PLAY)
±
ADJUSTMENT FOR VARIATIONS:
1. LITHOLOGY
2. PERMEABILITY
3. SOURCE BEDS
4. THERMAL HISTORY AND DEPTH OF BURIAL
5. EFFECTIVENESS OF SEAL
×
PROBABILITY THAT TRAPS EXIST
×
PROBABILITY THAT ACCUMULATIONS EXIST
(GIVEN THAT A TRAP EXISTS)
= POSSIBLE POTENTIAL RESOURCE

Figure 7 — Schematic diagram of procedure for estimation of Possible potential supply

necessary to ensure proper reservoir volume and yield adjustments and reasonable estimates for trap and accumulation discounts. The probabilities for the existence of traps and accumulations are dependent on how strongly the trend or play is established and the quality and quantity of available exploration data.

The estimation of *Speculative* potential supply (fig. 8) involves estimating accumulations which may be found in untested sediments located in either producing or nonproducing provinces. Estimates are based on whether or not conditions are considered favorable for gas accumulations. The factors considered include the type of sediments to be found, structural and stratigraphic relationships, tectonic history, and thermal maturation. Yield factors are estimated using known production statistics from other provinces. In these other provinces gas is produced from formations which are different from those in the speculative province, but characteristics of the formations in both provinces are believed to be similar. Adjustments are made to allow for dissimilarities between the two provinces being compared. The probabilities that the accumulations and traps exist are generally grouped together as one discount factor in order to derive the estimate of Speculative potential resources. The experience and judgment of the estimators are critical in making estimates of Speculative potential as they are in all resource estimation.

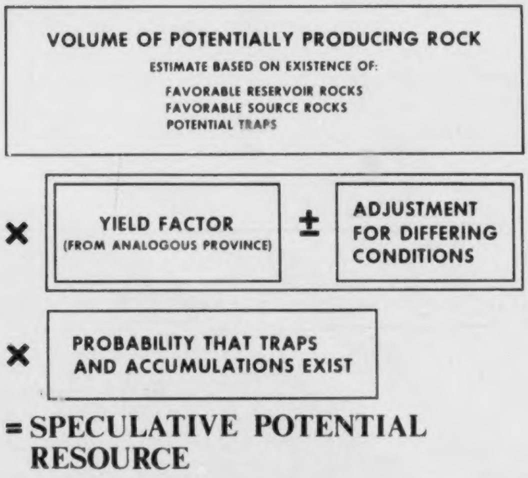
VOLUME OF POTENTIALLY PRODUCING ROCK
ESTIMATE BASED ON EXISTENCE OF:
FAVORABLE RESERVOIR ROCKS
FAVORABLE SOURCE ROCKS
POTENTIAL TRAPS
×
YIELD FACTOR
(FROM ANALOGOUS PROVINCE)
±
ADJUSTMENT FOR DIFFERING CONDITIONS
×
PROBABILITY THAT TRAPS AND ACCUMULATIONS EXIST
= SPECULATIVE POTENTIAL RESOURCE

Figure 8 — Schematic diagram of procedure for estimation of Speculative potential supply

Procedures in Estimation of Potential Gas Supply

Members of the Potential Gas Committee apply the preceding techniques for estimation of potential gas supply to each geologic province, sub-province or other geologic subdivision for which they are responsible. Natural gas accumulations generally are considered to occur in geologic basins, which are areas of thick sedimentary rocks which have accumulated in a topographic depression, resulting from tectonic processes during the geologic history of the region. However, there are some areas in the United States where natural gas has accumulated outside geologic basins (Plates I and II). Therefore, in resource estimation, inter-basinal areas must also be considered. Geologic provinces are large areas or regions which are unified in some way and which can be considered as a whole. In order to define provinces, similarity in geologic structure or stratigraphy exists throughout the province and is the defining characteristic. A geologic sub-province is a smaller area within the larger province, usually defined by close similarities in both geologic structure and stratigraphy, and in which either the same or closely similar formations exist throughout the province.

Resource estimates are made for each geologic region by members of the Committee. In many cases, especially where the potential resources are apparently quite large, two or more independent evaluations are made by individual members of the Area Work Committees. Differences between independent estimates are reconciled by discussion and re-evaluation. Each Area Work Committee, as a whole, reviews estimates of individual estimators and, based on the experience and knowledge of all members, accepts estimates presented or requests additional study and re-evaluation.

Each estimator considers three separate situations in preparing estimates:

1) The quantity of gas which might exist and be recoverable under the most favorable of geologic conditions. This assumes the maximum number of potential traps with favorable source bed and reservoir conditions, and each trap filled with recoverable accumulation. Such conditions would lead to the maximum possible resource estimate.
2) The existence of the minimum number of traps, the most marginal of source bed and reservoir conditions, and the possibility that many of the traps which might exist would not contain recoverable accumulations of natural gas. Such conditions would lead to a minimum estimate of the resource.
3) The most reasonable estimate both of the existence of traps and accumulations and the most reasonable assessment of the source bed and reservoir conditions. Such conditions would lead to the most likely estimate of the resource.

By considering all three of these situations, the estimator is best able to express both the limiting conditions within the geologic region and, also, conclude the most likely conditions to exist. Only those estimates considered to be most likely are reported by the Potential

Gas Committee. Neither the most optimistic outlook, resulting in a maximum estimate, nor the most pessimistic outlook, resulting in a minimum estimate, is believed to be a sound basis for future planning. The estimates which are reported are the best considered judgment of the members of the Committee based on their evaluation of all information available to them. However, it should be noted that there is a degree of uncertainty associated with each estimate which cannot be resolved until exploration, drilling, and production have been completed. The degree of uncertainty differs for each of the resource categories of the Committee. This uncertainty is discussed in more detail below. In order to present estimates for the reporting areas and depths of the Potential Gas Committee and for the United States as a whole, the most likely estimates for each of the geologic regions (provinces, sub-provinces, basins, etc.) are accumulated to form the totals.

Role of Judgment

The judgment of the estimator is the most significant factor in making estimates of potential supply, particularly in the resource categories of *Possible* and *Speculative*. Members of the Potential Gas Committee, having the detailed knowledge and the experience necessary to select the appropriate adjustments for an assigned geological province, use all available pertinent geological and engineering data to reflect an objective, scientific approach to the problem.

INTERPRETATION OF POTENTIAL GAS COMMITTEE ESTIMATES

The estimates presented by the Potential Gas Committee for each of the reporting areas and for each of the resource categories are statistically the *most likely* or *modal* estimates and represent the quantity of natural gas which has the highest probability of occurrence. The actual volume of ultimately recoverable natural gas within the crust of the earth is a fixed, but unknown, quantity. Consequently, the estimates made by the Potential Gas Committee necessarily involve uncertainty as to whether the best estimate of the Committee corresponds to the actual quantity of recoverable natural gas. The degree of uncertainty increases with decreasing availability of geological, geophysical and engineering information—hence, the Committee's use of the categories Probable, Possible and Speculative. *The categories Probable, Possible and Speculative relate only to the degree of certainty of the accuracy of the estimates because of the differing availability of data upon which the categories of estimates are based; the estimates presented for each category represent the Committee's objective judgment of the estimate with the highest probability of occurrence.*

It is believed that the Committee's estimates represent a distribution such that the most likely or modal estimates correspond closely to the statistical mean. Since estimates for an area are derived by combining estimates from sub-areas, it is reasonable to assume that the area estimates will follow a normal probability distribution. On this assumption, the Committee's estimates of minimum, most likely and maximum could be represented as lower, modal and upper points on a normal probability curve, and such a curve is symmetrical about the mode. The lower value corresponds to an approximately 90 percent probability that there will be at least this lower amount of recoverable gas, and the upper value corresponds to an approximately 10 percent probability that there will be this upper amount of recoverable gas.

The relationship of the most likely estimates to the probability of occurrence of natural gas resources may perhaps be best explained by reference to a hypothetical plot of the actual probability of occurrence of the given quantity of natural gas in an area (fig.9).

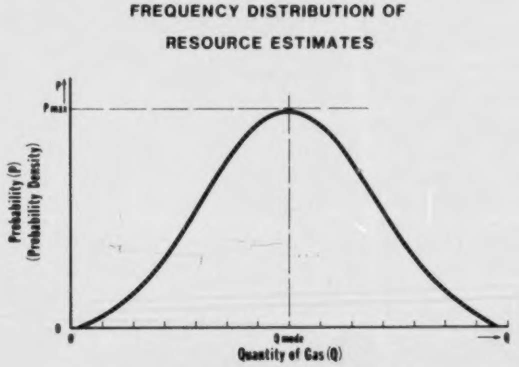

Figure 9 — Hypothetical plot of the actual probability of occurrence of the given quantity of natural gas in an area

Figure 9 demonstrates that there is the highest probability (P max) of the occurrence of a given quantity (Q mode) of natural gas at the highest, or modal, point of the curve. This Q mode is the quantity estimated by the Potential Gas Committee based on the best judgment of the members. There is a correspondingly lower probability that the actual quantity of natural gas will be something other than Q mode. Lower or higher estimates extending toward the minimum and maximum quantities which might be present can be derived by varying either the evaluation of the geologic factors which control occurrence or the discount factors applied to both the possibility of the occurrence of the trap and the accumulation of trapped gas. For example, if the reservoir conditions are not as favorable as judged by the Committee, then the quantity of gas which can be recovered would be less than that estimated by the Committee. On the other hand, if the reservoir conditions are more favorable, the quantity would be higher. Also, if the probability of both the existence of the trap and the accumulation of gas within the trap are either higher or lower, the quantity would also vary. While recognizing the possibility of this variation, members of the Potential Gas Committee feel that the most likely estimate which they present represents the best considered judgment of the Committee members as to the characteristics which exist within the area under consideration.

The "tightness" of the actual probability curve for an individual area, or the measure of uncertainty corresponding to the estimate of Q mode, will vary according to the quantity of data upon which the estimates are based and will, therefore, vary between the Probable, Possible and Speculative categories.

It can be seen from the shapes of the curves in figures 10, 11 and 12 that there is greater uncertainty about the estimate of natural gas which is to be reported as the most likely quantity for the Speculative category than for the Probable or Possible categories. That is, there is a greater range of estimates of natural gas with a relatively high probability of occurrence and, therefore, selection of the most likely estimate for the Speculative category is more difficult than for the other categories. The uncertainty diminishes in the Possible and Probable categories with the estimate of the Probable quantity being the most certain because the greatest amount of information is available.

For Probable estimates:

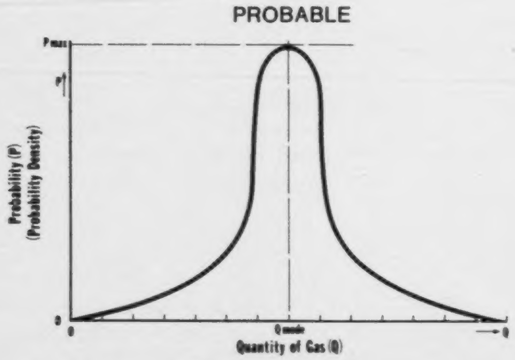

Figure 10 — Hypothetical plot of the probability of occurrence of estimates for the Probable category

For Possible estimates:

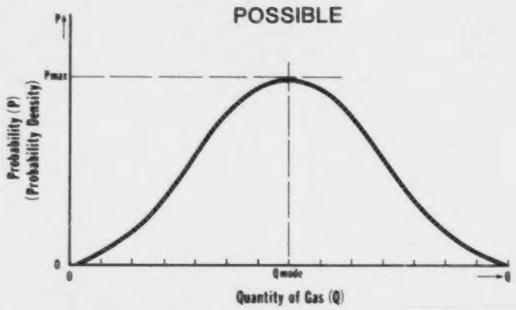

Figure 11 — Hypothetical plot of the probability of occurrence of estimates for the Possible category

For Speculative estimates:

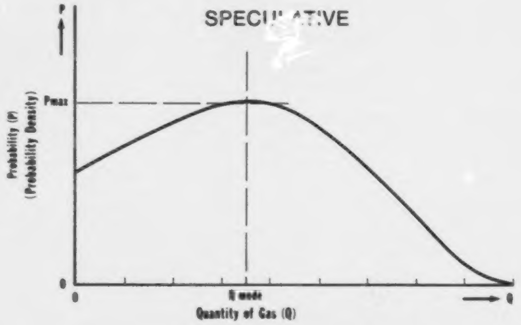

Figure 12 — Hypothetical plot of the probability of occurrence of estimates for the Speculative category

A significant point to be observed in the hypothetical probability plot for the Speculative category (fig. 12) is that there is a reasonably high probability that no recoverable natural gas resource at all exists in the area under consideration. Based on the uncertainty of knowledge concerning Speculative resources, it is not surprising that there is a good chance of finding no viable gas resources at all as the result of future exploration efforts. Such a possibility of no recoverable resources also exists for the Possible resources and, to a much lesser extent, for the Probable resources. However, the probability of no recoverable gas resources is much lower for Possible resources than for Speculative resources because the existence of gas resources has already been demonstrated in the geologic province and potential reservoir formations under consideration. In the case of Probable resources, the probability of no recoverable gas resources is virtually nil.

Under the conditions related to the estimates of the Potential Gas Committee, within each category the most likely estimates for each individual basin, province or trend are additive and can be combined to give the estimate for the area. The individual components of the area totals are not normally divulged by the Potential Gas Committee for two reasons, the first being that the Committee's work is often based on confidential information shared with Committee members by employers and associates. It is this shared confidential information which gives a broader base of data and greater detail and credibility to the estimates of the Committee. However, the sharing of confidential information carries with it the requirement that the confidentiality is not compromised by releasing estimates for areas which are so small that the basic data would be indirectly revealed. The reporting areas chosen by the Potential Gas Committee are large enough that the confidentiality of information is protected and yet small enough to be geologically coherent. The second reason is that, particularly when dealing with estimates of resources in the Speculative category, there may be a considerable range of uncertainty in the resource estimates for any individual basin, province or trend. By combining individual estimates for an entire area, it is hoped that overly optimistic individual estimates may be counterbalanced by other, more conservative, individual estimates and, thus, a realistic most likely estimate for the area can be achieved.

Limiting Considerations

The estimate presented here is limited to the contiguous United States, Alaska, and adjacent offshore areas. Hawaii, the island territories and their adjacent offshore areas are not included.

No potential supply of natural gas is included which exists at subsurface depths greater than 30,000 feet or, in offshore areas, where water depths are in excess of 1,000 meters (3,281 feet). Separate evaluations are made for the potential supply existing at onshore drilling depths from 0 to 15,000 feet and from 15,000 to 30,000 feet. These subdivisions recognize the greater technological and economic difficulty of recovering resources that exist below drilling depths of 15,000 feet. In offshore areas, estimates are made for the potential existing beneath water depths of 0 to 200 meters (656 feet) and 200 to 1,000 meters (3,281 feet). Estimates for water depths less than 200 meters essentially represent the potential supply that may be recovered from beneath the Continental Shelf whereas the estimates for water depths of 200 to 1,000 meters essentially represent resources that may be recovered from beneath portions of the Continental Slope.

The extension of Potential Gas Committee estimates in 1978 to include offshore areas beneath water depths up to 1,000 meters (3,281 feet) was a significant increase from the previous depth limit of the 1968 through 1976 reports which included resource estimates out to a water depth of 1,500 feet. In the opinion of Committee members, there has been sufficient improvement in drilling, production and offshore pipeline technology to warrant this extension of limits in keeping with the Committee's concept of including all natural gas resources which could be produced in the future with normal advances in technology. There still remain questions as to the capability of completing pipeline connections in offshore water depths as great as 1,000 meters. The Committee has chosen, however, to be optimistic in its outlook and to present these estimates, recognizing that the above technical questions remain unanswered.

Estimates made by the Area Work Committees include resources which exist beneath areas presently withdrawn or proposed for withdrawal from exploration and development because of governmental action. Where there exists considerable potential beneath areas so withdrawn, it is appropriate for an estimate to be made of this potential and that estimate to be presented in the narrative portion of the report submitted by each Work Area.

Economic, technological and governmental policy considerations that are taken into account in the Potential Gas Committee's estimate of potential gas supply are related to (1) past production and proved reserves of natural gas, and (2) all wells which would be drilled in the future under the assumed conditions of adequate economic incentives in terms of price/cost relationships and current or foreseeable technology. Fundamental economic considerations - which include but are not limited to prices, costs, rates of take, recovery factors, abandonment pressures, etc. - are inherent in the definition of proved reserves: " . . . recoverable in the future from known oil and gas reservoirs under existing economic and operating conditions." Some gas that is actually present in known reservoirs is not producible because of the relationship between costs and prices, and therefore is not included in recoverable reserves.

Furthermore, there are other known gas accumulations of such small size that none of the gas can be produced in commercial quantities under ". . . existing economic and operating conditions." Such considerations result in proved reserves being something less than the total volumes of gas existing in known reservoirs. These same limitations are applicable to the estimates of potential supply. If a fundamental change in economics or technology occurs, estimates of potential supply will be changed accordingly.

The attribution technique presented in the Estimation of Potential Gas Supply section describes relationships between ultimately recoverable volumes of gas from known occurrences and prospective gas accumulations, after appropriate adjustment for variations in geological and reservoir conditions are made. The explicit assumption of adequate but reasonable prices and normal improvements in technology in the definition of potential supply relates to improvements in exploration and production techniques. Adequate prices, normal techno-

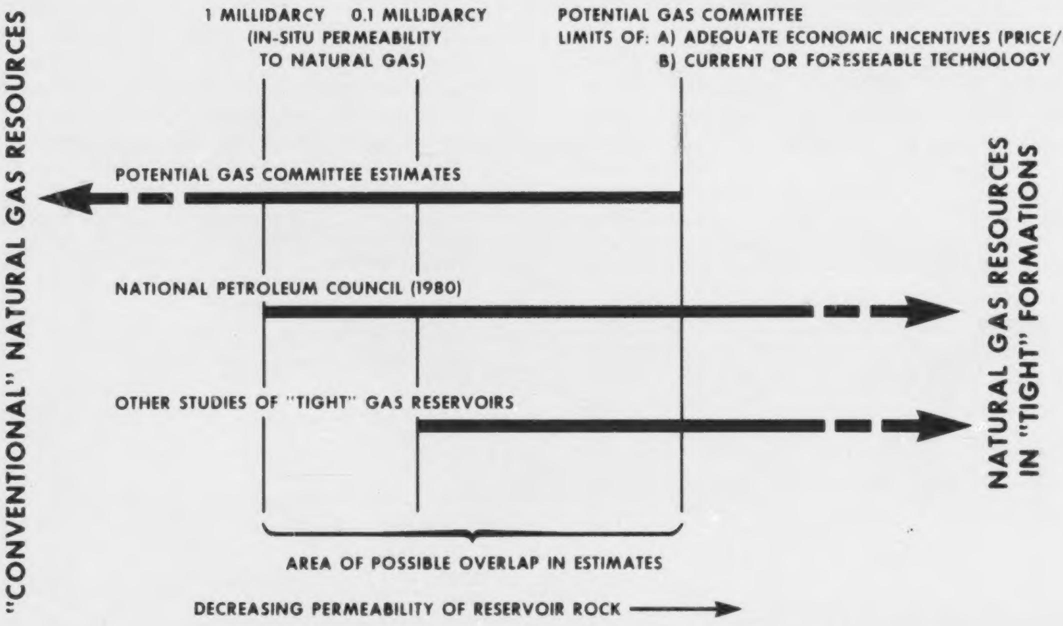
1 MILLIDARCY
0.1 MILLIDARCY
(IN-SITU PERMEABILITY TO NATURAL GAS)
POTENTIAL GAS COMMITTEE LIMITS OF: A) ADEQUATE ECONOMIC INCENTIVES (PRICE/COST) B) CURRENT OR FORESEEABLE TECHNOLOGY
"CONVENTIONAL" NATURAL GAS RESOURCES
POTENTIAL GAS COMMITTEE ESTIMATES
NATIONAL PETROLEUM COUNCIL (1980)
OTHER STUDIES OF "TIGHT" GAS RESERVOIRS
NATURAL GAS RESOURCES IN "TIGHT" FORMATIONS
AREA OF POSSIBLE OVERLAP IN ESTIMATES
DECREASING PERMEABILITY OF RESERVOIR ROCK

Figure 13 — Schematic representation of the relationship between Potential Gas Committee resource estimates and estimates of natural gas resources in low permeability formations

logical improvements and reasonable governmental policies are required to bring about the drilling necessary to prove the potential supply. These assumed conditions permit estimates of potential supply to be made by the Potential Gas Committee on the basis of relevant past history and experience concerning recovery factors, as well as the size and type of reservoirs which have been found, developed, and produced, without speculating as to future levels of prices and costs.

In this report no potential supply of natural gas is included which might be recovered from geopressured-geothermal brines of the U.S. Gulf Coast regions, directly from gaseous coal seams, or from gas hydrates. Where coals may have served as source beds for gas accumulations in conventional sandstone or limestone reservoirs, the potential resource contained in the conventional reservoir and recoverable by conventional drilling and production is included in the Committee's estimates. The potential resource from certain black (Devonian) shales is largely excluded except that potential which the Committee believes to be recoverable by normal drilling and well stimulation and completion techniques and which is analogous in geologic setting to previous production. The natural gas potential from tight (low permeability) formations (including sandstone, shale and carbonate reservoirs) is included in the Committee's estimates to the extent that these resources fall within the limiting considerations for resource estimation.

The inclusion of resources from tight formations raises questions concerning the relationship of the estimates of the Committee to the estimates prepared by others for the resources in tight formations. No clear definition of the upper limits of what constitutes a tight gas formation has been given by most workers who have prepared estimates in the past. Some of the more recent estimates have included resources in formations with **in situ** effective permeabilities of up to 1 millidarcy. In the preparation of year-end 1982 estimates, the Potential Gas Committee has considered the question of the magnitude of the resources included in the Committee's estimates which might lie in formations which have **in situ** effective permeabilities to natural gas of less than 0.1 millidarcy. Such resources may occur in reservoir rocks of any lithology including sandstones, shales and carbonate rocks.

Figure 13 illustrates diagrammatically the overlap of resource estimates prepared by the Potential Gas Committee with the estimates prepared by others who have investigated the unconventional resource potential which may exist in formations with low permeability. Previous studies have concentrated largely on Western "tight gas sands" and Eastern Devonian shales. Estimates of the Potential Gas Committee extend from "conventional" resources to the limits of technology and economic considerations used as limiting considerations by the Committee. The Committee has determined that presently about 20 percent of its estimated resources in all categories, or about 172 trillion cubic feet, is contained in formations which have **in situ** permeabilities to natural gas of less than 0.1 millidarcy. These quantities have been incorporated gradually, over a number of years, into the Committee's estimates as changing technology and economic conditions have transformed a former "unconventional" resource into a "conventional" resource. Thus, currently, about 20 percent of the Potential Gas Committee estimate is probably included also in the resource estimates of those who have studied the potential from "tight gas sands" and Devonian shales. The overlap of estimates of potential with the estimates made by the National Petroleum Council study committee[1] is not known because the NPC study of tight gas formations included an undefined quantity of resources from formations with permeabilities as high as 1 millidarcy.

A review of nonconventional natural gas resources was prepared by the Potential Gas Agency and presented in Part II of the Potential Gas Committee report for 1982.[2] This review was not an independent appraisal by either the Potential Gas Committee or Potential Gas Agency of the volume of natural gas within nonconventional sources. Its purpose was knowledge and the direction of research relative to nonconventional sources of natural gas and to present published estimates of the potential from such sources. The reader is referred to this report for further information.

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[1] National Petroleum Council, 1980, Unconventional Gas Sources - Volume V - Tight Gas Reservoirs.

[2] Potential Gas Committee, 1981, Potential supply of natural gas in the United States (as of December 31, 1980): Potential Gas Agency, Colorado School of Mines, Golden, 119 p.

Estimate of Potential Supply of Natural Gas

TOTAL UNITED STATES

The potential supply of natural gas in the United States, excluding Hawaii and island territories, as of December 31, 1982, is estimated to be 192 trillion cubic feet in the Probable category, 355 trillion cubic feet in the Possible category, and 329 trillion cubic feet in the Speculative category (table 2). Figure 14 shows the geographic distribution of the potential supply as estimated by the Potential Gas Committee for each of the reporting areas for onshore and offshore resources. Portions of this potential are less accessible than others due to technological and economic limitations. Recognizing the importance of accessibility, the potential resources have been summarized in table 3 by depth increments and by offshore water depth. The potential supply in Alaska is listed separately because of the unique conditions surrounding its accessibility to the United States' market and because Alaska is in the early stages of exploration. In all tables, dashes are used to indicate estimated potential of less than 0.5 Tcf. All estimates are based upon the volume of raw gas at 14.73 psia and 60° F.

Table 2 — Estimated potential supply of natural gas in United States by geographic areas
as of December 31, 1982
(trillions of cubic feet at 14.73 psia and 60° F.)

Area		Probable	Possible	Speculative
A	Onshore	27	8	33
	Offshore	—*	—	16
B	Onshore	6	6	7
	Offshore	1	2	28
C	Onshore	—	2	1
D	Onshore	8	20	19
E	Onshore	6	15	—
	Offshore	21	36	—
G	Onshore	12	15	4
	Offshore	11	16	—
H	Onshore	49	93	66
I	Onshore	2	3	1
J-North	Onshore	24	60	39
J-South	Onshore	15	33	1
L	Onshore	2	8	8
	Offshore	—	9	9
	48 States Subtotal	184	326	232
K	Alaska - Onshore	6	16	28
	- Offshore	2	13	69
	Total United States	192	355	329

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*In all tables, dashes are used to represent estimates of potential of less than 0.5 Tcf.

Table 3 — Total estimated potential supply of natural gas by depth increments
(trillion cubic feet)

	Probable	Possible	Speculative
Onshore (Drilling Depth)			
Lower 48 States			
less than 15,000 feet	103	133	83
15,000 to 30,000 feet	48	130	96
	151	263	179
Alaska			
less than 15,000 feet	6	16	28
15,000 to 30,000 feet	—	—	—
	6	16	28
Total Onshore	157	279	207
Offshore (Water Depth)			
Lower 48 States			
less than 200 meters	30	41	30
200 to 1,000 meters	3	22	23
	33	63	53
Alaska			
less than 200 meters	2	13	59
200 to 1,000 meters	—	—	10
	2	13	69
Total Offshore	35	76	122
Total Lower 48 States	184	326	232
Total Alaska	8	29	97
Total United States	192	355	329

Probable Category

Within the onshore area of the lower 48 states, 68 percent of the Probable potential lies at drilling depths less than 15,000 feet and 32 percent lies at drilling depths between 15,000 and 30,000 feet. Eighty-two percent of the lower 48 Probable potential is in onshore areas and 18 percent in offshore areas. Within the offshore area of the lower 48 states, 91 percent of the estimated Probable potential lies beneath water depths of less than 200 meters. Ninety-six percent of the total United States Probable potential is considered to exist within the lower 48 states and 4 percent in Alaska.

Possible Category

Within the onshore area of the lower 48 states, 51 percent of the estimated Possible potential lies at drilling depths less than 15,000 feet and 49 percent lies at drilling depths between 15,000 and 30,000 feet. Eighty-one percent of the lower 48 Possible potential is in onshore areas and 19 percent in offshore areas. Within the offshore areas of the lower 48 states, 65 percent of the Possible potential lies beneath water depths of less than 200 meters and 35 percent lies beneath water depths between 200 and 1,000 meters. The Possible potential for the lower 48 states is 92 percent of the total Possible potential supply while that for Alaska is 8 percent.

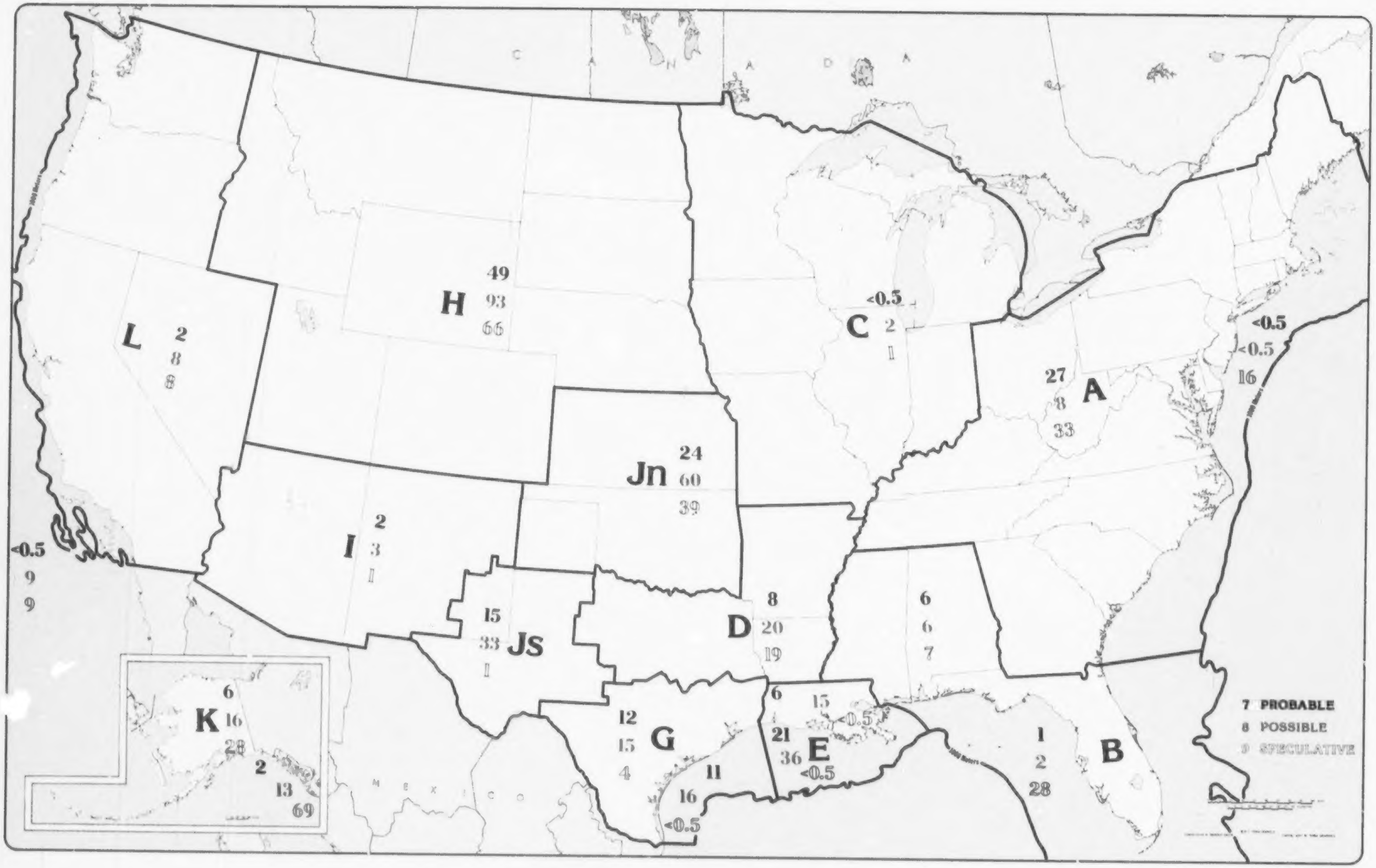

Figure 14 — Geographic distribution of potential supply as estimated by the Potential Gas Committee

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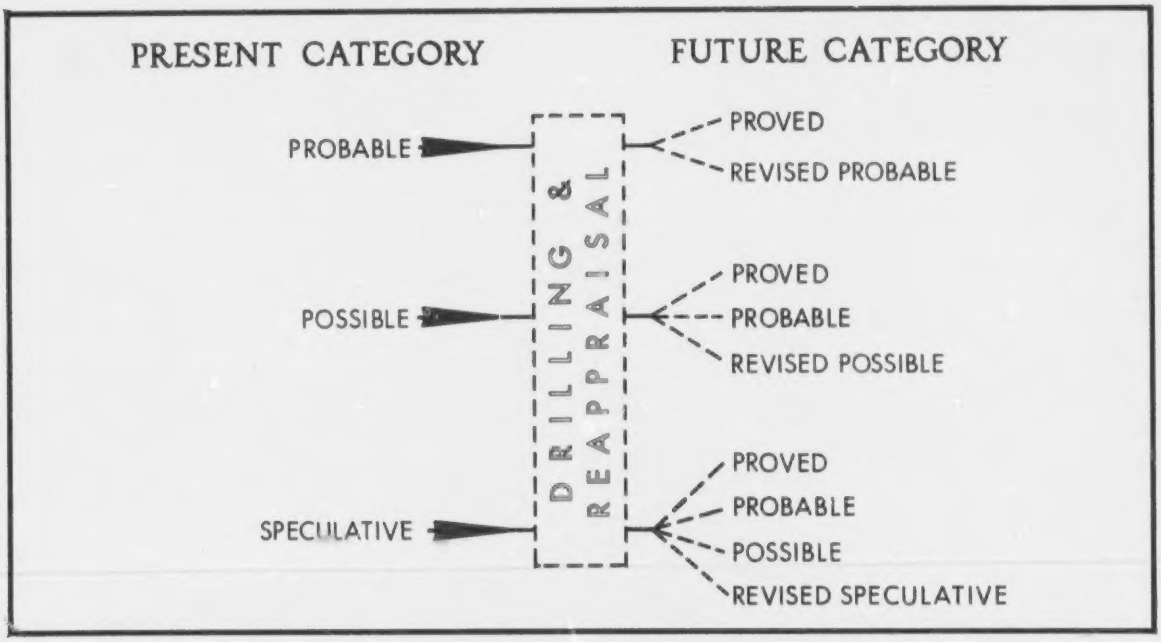


Figure 15 — Schematic representation of progression of potential gas supplies as a result of drilling and reappraisal

Speculative Category

Within the onshore areas of the lower 48 states, 46 percent of the estimated Speculative potential lies at drilling depths less than 15,000 feet and 54 percent lies at drilling depths between 15,000 and 30,000 feet. Seventy-seven percent of the lower 48 Speculative potential is in onshore areas and 23 percent in offshore areas. Within the offshore areas of the lower 48 states, 57 percent of the potential Speculative supply lies beneath water depths of less than 200 meters and 43 percent beneath water depths of 200 to 1,000 meters. The estimated Speculative supply for the lower 48 states is 71 percent of the total United States Speculative potential and the estimated Alaskan potential is 29 percent.

Comparisons with 1980 Report

Changes in estimates in each of the categories represent re-evaluation based on additional drilling. As drilling progresses, gas volumes estimated to be in a particular reservoir will move from one category to another as shown schematically in figure 15. Since any projection of potential supply lacks the accuracy of proved reserve figures, particularly in the Speculative category, it must be recognized that these estimates of potential supply will be subject to upward and downward revisions as new geological and engineering data are provided by exploratory drilling.

This report reflects continued shifts in the pattern of distribution of estimated potential supply when compared to the report prepared for year-end 1980 and to those for previous years. An increasing percentage of the potential resource is believed to lie at depths greater than 15,000 feet in onshore areas of the lower 48 states compared to shallower depths in the same areas. In 1978, 32 percent of the total onshore lower 48 resource was considered to lie below 15,000 feet. This percentage increased to 39 percent in 1980 and to 46 percent in this current report. This shift appears to result from the combination of continued development of resources from shallow, mature areas and the addition of resource potential based upon the encouraging results of increased deep exploration and drilling during the past two years. The estimate of deep resource potential has increased from 199 Tcf in 1978 to 240 Tcf in 1980 and to 274 Tcf in 1982.

The balance between onshore and offshore resources in the lower 48 states remained the same as for 1980 with 80 percent of the resource believed to exist in onshore areas and 20 percent in offshore areas. The decrease in the offshore estimates from 157 Tcf in 1980 to 149 Tcf in 1982 represents largely the maturity of the Gulf Coast region and the continued development of its resources. There has been a shift of some offshore potential in Area B from Speculative to Possible and Probable because of recent discoveries at the mouth of Mobile Bay.

Alaska is now estimated to contain 15 percent of the total resource potential compared to 16 percent in 1980 and 19 percent in 1978. The results of geophysical surveys and wildcat drilling have diminished what was previously considered to be prospective acreage in Alaska.

AREA REPORTS

Area A: Ohio, Kentucky, Tennessee, Georgia, and All States Farther East and Adjacent Offshore

Area A includes the Appalachian basin, the southern portion of the Illinois basin, the Triassic basins and the Offshore Atlantic. The Area has oil and gas production from the Appalachian foreland and Valley and Ridge regions and includes the region of oldest gas and oil production in the United States. All current production is onshore, although several attempts have been made to establish production offshore in both the Baltimore Trough and Georges Bank basin areas.

The Appalachian Mountains are the oldest major mountain group in the United States, having been deformed during both early and late Paleozoic time. Extensive "sheets" of sedimentary rocks are gently folded in the main Appalachian basin but are more complexly and tightly folded in the Valley and Ridge area to the east. Much recent attention has been focused on the "Appalachian or 'Eastern' overthrust belt", the covered portion of which includes the Blue Ridge Mountains and Piedmont of the Appalachian provinces. To date no major oil and gas discoveries have been made in the older rocks of this belt.

Paleozoic reservoirs of the Appalachian foreland supply most of the production in this area. Cambrian and younger rocks all have potential. Rocks of younger than Permian age are not present. Sandstones, limestones and fractured shales produce. The Cincinnati arch of Ohio, West Virginia and Kentucky is a major geologic structure which controls production from both structural accumulations and stratigraphic trapping.

Although most of the Area's production is from the Appalachian foreland, some production is in northwest Ohio, arcing across the southwestern margin of the Michigan basin. Scattered production in the Kentucky part of the Illinois basin is also included in this Area.

Major interest in gas potential of Devonian black shales remains; these shales have poor permeability, but, where naturally fractured, can produce gas in commercial quantities.

There have been no significant changes in the estimates of potential gas resources for Area A in 1982 compared to 1980. Discoveries have resulted in shifting of 1 Tcf from Possible to Probable resources. Continued disappointments in the exploration of offshore areas have caused Committee members to reduce further the estimate for potential gas resources in the offshore portion of Area A by 2 Tcf.

New interpretations of Appalachian geology, especially the concept of the Eastern Overthrust Belt, have spurred exploration. Wildcat drilling is taking place from the southern boundary of Area A in Tennessee to the northern portion in western Vermont. There is also renewed interest in the possibility of gas accumulation in Triassic fault-block basins along the Atlantic margin. Hopefully, the results of this exploration will lead to better evaluation of the resource potential of portions of this area where the geologic setting and structural characteristics are still only poorly known.

Table 4 — Area A. Eastern United States
Ohio, Kentucky, Tennessee, Georgia, and all states farther east
and adjacent offshore
(trillion cubic feet)

	Probable	Possible	Speculative
Onshore (Drilling Depth)			
less than 15,000 feet	27	8	22
15,000 to 30,000 feet	—	—	11
Total	27	8	33
Offshore (Water Depth)			
less than 200 meters	—	—	11
200 to 1,000 meters	—	—	5
Total	—	—	16
Area A total	27	8	49

Area B: Mississippi, Alabama, Florida and Adjacent Offshore

The principal prospective areas in Area B include the Mississippi-Alabama Interior Salt basin of south Mississippi, southeastern Alabama and the very western portion of the Florida panhandle, and the Black Warrior basin of northeastern Mississippi and northwestern Alabama. Other areas of interest include the Wiggins uplift and the Hancock Ridge of south Mississippi, the offshore extension of the Mobile graben and the Appalachian thrust belt of northern Alabama.

The Interior Salt basin and the Mobile graben area of lower Mobile Bay, has prolific production from Jurassic-age rocks which include the Cotton Valley, Smackover and Norphlet Formations. The Interior Salt basin also has production from Late and Early Cretaceous age rocks, with the Hosston Formation being the most important Lower Cretaceous gas producer. Cenozoic production is found in southwestern Mississippi from the Wilcox Group of the Eocene and from Miocene sandstones in south Alabama and just offshore. Salt uplift and the associated faulting are the principal trapping mechanisms in these areas, but stratigraphic traps also form accumulations either on regional dip or associated with nosing or salt-related features. The stratigraphy consists primarily of clastic rocks with the exception of the Selma Chalk of Late Cretaceous age, the James Limestone and Sligo Formation of Early Cretaceous age and the Smackover Formation of Jurassic-age. The Smackover produces from both dolomite and oolitic limestones.

Paleozoic production in Area B is found in the Black Warrior basin. Production is from Pennsylvanian and Mississippian sandstones with a small portion of production from the Mississipian Bangor Limestone. No significant production has been established from Cambrian or Ordovician rocks. Most of the production is structurally controlled except for an area of Fayette County, Alabama, where production is stratigraphically controlled. Exploration for Paleozoic production in the Appalachian overthrust of Alabama is just beginning and will be an area of interest for the next several years.

The 1982 estimate of potential gas resources for the southeastern states of Mississippi, Alabama, Florida and the adjacent offshore areas out to the 1,000 meter water depth is 50 Tcf. This is a reduction of 4 Tcf (7.4%) from that estimated in the 12/31/80 report. The changes in the estimate of potential gas resources onshore has resulted in a 2 Tcf downward revision from the 12/31/80 estimate. These changes are due to the disappointing results of wildcat drilling in the area. The potential gas resources estimate for the offshore portion of Area B has also been lowered by 2 Tcf. This reduction was prompted by the results of drilling in the South Florida basin area. As a result of the drilling being done in the lower Mobile Bay area of Alabama, 3 Tcf has been moved from the offshore Speculative category into the Probable category (1 Tcf) and Possible category (2 Tcf).

The primary exploration effort onshore has been to extend the Hosston production into other areas and to develop reserves in the deep Cotton Valley trend of south Mississippi. The results of both of these efforts have been disappointing. In west-central Mississippi, where the Cotton Valley is shallower, several discoveries have been made. This is an area in which exploration activity will expand. In the Black Warrior basin of northwestern Alabama and northeastern Mississippi, there continues to be strong interest in exploration and development of shallow Palezoic fields. The thrust and fold belt of Alabama is beginning to experience an exploration thrust for Paleozoic production.

Table 5 — Area B. Southeastern United States
Mississippi, Alabama, Florida and adjacent offshore
(trillion cubic feet)

	Probable	Possible	Speculative
Onshore (Drilling Depth)			
less than 15,000 feet	4	3	3
15,000 to 30,000 feet	2	3	4
Total	6	6	7
Offshore (Water Depth)			
less than 200 meters	1	2	15
200 to 1,000 meters	—	—	13
Total	1	2	28
Area B total	7	8	35

Development drilling in the lower Mobile Bay field continues with 4 wells completed. Three wells were completed in the Jurassic and the fourth was completed in the Miocene. One well is presently drilling and three others are permitted.

There have been no tight gas sands so designated in Area B to date. Several formations meet the requirements to be classified as tight gas sands in some portions of Area B. Estimates indicate that 2 Bcf (4%) of the potential gas resources in this area may be found in tight gas sands.

Area C: Minnesota, Wisconsin, Michigan, Iowa, Illinois, Indiana, and Missouri

Area C comprises the Michigan basin, the Illinois basin and Forest City basin. Oil and gas development in Area C is largely restricted to the Michigan basin, Kankakee arch, and Illinois basin, although a much broader geographic area is included. A minor amount of hydrocarbon production occurs in the Missouri portion of the Forest City basin.

Production is from Ordovician through Pennsylvanian-age rocks, both sandstones and carbonates. The major exploration targets in the Michigan basin are Middle Silurian Niagaran pinnacle reefs. In addition, there is increased interst in exploring the central basin area of the Michigan basin where deeper drilling on known Mississippian and Devonian structures has been rewarded mainly with oil pays in the Devonian Richfield interval. The first production of gas from the Ordovician Prairie du Chien Group in north-central Michigan has generated great interest in finding more production from depths greater than 10,000 feet. The giant Trenton Field of Indiana produces from shallow Ordovician dolomites (and has since 1886); Devonian and Mississippian reservoirs are more common in the Illinois basin.

Area C has not been severely deformed during Phanerozoic time, although severe earthquakes from motion along ancient fracture systems have shaken southeastern Missouri as well as parts of Illinois. Large arch and basin systems with low relief are characteristic of the region. Lack of source rocks coupled with thin sedimentary cover and lack of thermal maturity have apparently precluded formation of hydrocarbon pools in Minnesota, Wisconsin and Iowa.

The December 31, 1982, total potential gas supply estimate has been revised downward from the 1980 estimate by approximately 60 Bcf because of exploration results related to new Devonian gas resources and because of the transfer of 400 Bcf of potential Silurian resources to proved reserves and production. These decreases were offset partially by an increase of 265 Bcf in the estimate of potential supply that is attributed to other Prairie du Chien gas resources believed to be in the Michigan basin. Although the net result of these changes is a decrease of 195 Bcf in the overall estimate for Area C, this has not resulted in a change in the reported estimates of Possible and Speculative potential because of Committee policy to round estimates to the nearest trillion cubic feet.

The major current exploratory activity continues to be Niagaran pinnacle reefs in the Michigan basin.

Currently, the potential gas resource assigned to offshore areas of the Great Lakes is not available for development because of Michigan legislation and State Natural Resource Commission policy.

Table 6 — Area C. North Central United States
Minnesota, Wisconsin, Michigan, Iowa, Illinois, Indiana, and Missouri
(trillion cubic feet)

	Probable	Possible	Speculative
Onshore (Drilling Depth)			
less than 15,000 feet	—	2	1
15,000 to 30,000 feet	—	—	—
Area C total	—	2	1

Area D: Arkansas, North Louisiana, and Central Texas (RR Comm. Dists. 5, 6, 7B and 9)

From the standpoint of prospective areas, Area D includes the North Louisiana, East Texas, Forth Worth and Hardeman geologic basins as well as the southern part of Arkansas south of the Ouachita System forelands. Three major producing regions occur in Area D: Eastern Arkoma basin production in northwestern Arkansas, the East Texas and Northern Louisiana basins in the central part of Area D, and the Fort Worth basin and North-Central Texas shelf in the west. These are structurally and stratigraphically diverse areas representing three geologic provinces.

Paleozoic rocks are major producers in the Arkoma basin to the north of the Ouachita fold belt and south of the Ozark dome. This area was deformed during Mississippian and Pennsylvanian time. The lower Paleozoic rocks are shelf limestones and clastics; upper Paleozoic rocks tend to be more dominantly clastic. North-Central Texas production is largely from Pennsylvanian clastic rocks.

The eastern Texas, southern Arkansas and northern Louisiana production is from the East Texas basin, the Sabine uplift, and the Northern Louisiana basin. This famous area produces from sandstones and some limestones of Jurassic, Cretaceous and Eocene age. Jurassic Smackover, Eocene Wilcox and, more recently, Jurassic Cotton Valley reservoirs produce large quantities of gas, with the deep Cotton Valley in the East Texas basin being a major target in recent times.

The estimates for all categories of potential supply in Area D were reduced from the last report, with Probable reduced 1 Tcf, Possible reduced 2 Tcf and Speculative reduced 1 Tcf, for a total reduction of 4 Tcf covering the three categories. These reductions were due mainly to the shifting of potential supply to proved reserves and production as a result of the high level of exploration across almost all portions of Area D since the last report. Drilling activity has decreased somewhat from the record pace seen in 1981; however, considerable exploration activity continues in most basins of Area D.

Table 7 — Area D. Arkla-Tex
Arkansas, North Louisiana, and Central Texas
(RR Comm. Dists. 5, 6, 7B & 9)
(trillion cubic feet)

	Probable	Possible	Speculative
Onshore (Drilling Depth)			
less than 15,000 feet	8	20	15
15,000 to 30,000 feet	—	—	4
Area D Total	8	20	19

Area E: South Louisiana and Offshore Louisiana

Area E comprises the Louisiana Gulf Coast onshore and offshore. Sedimentary rocks of Cretaceous (Tuscaloosa), Eocene (Wilcox), Oligocene (Frio-Hackberry) and Miocene age were deposited by overlapping and coalescing Mississippi River drainage flood plains and delta complexes in the onshore part of Area E. Structures, especially salt domes and faulting, which were actively moving during deposition of these sandstones and shales formed composite stratigraphic-structural traps as well as less-complex structural traps. In the offshore Louisiana province, rapid sedimentation of clastic sediments continued into more recent geologic times and has provided reservoir rocks of younger age. Production offshore is largely from Miocene, Pliocene and Pleistocene rocks.

The onshore and offshore areas are both well known for the production associated with salt domes. These large structures are piercements formed by the upward movement of the Louann Salt (Jurassic). This upward movement disrupted normal sedimentary layers and created oil and gas traps at the contacts between upturned edges of sandstones and impervious salt. These salt diapirs are probably caused by unequal loading of heavy sediments on the relatively low density salt beds or by movement along growth faults. The caps of the salt diapirs commonly contain large amounts of native sulfur.

The estimated potential supply of natural gas from Area E has been decreased by 3 Tcf from the estimates of 12/31/80. The new estimate of the total potential supply is 78 Tcf. Virtually all of the decrease in estimates is related to transfers from potential supply to proved reserves in this actively developing area. The net result of evaluation of new data and reappraisal of earlier estimates accounts for the remainder of the decrease.

The major exploratory activity in Area E continues to be the deep Tuscaloosa Trend, which extends in a belt approximately 20 miles wide and 300 miles long from Texas to Mississippi across the northern portion of south Louisiana. Over 30 discoveries have been made in the trend since the play began in 1975, and both exploratory and development drilling is still active, although at about half the level of two years ago. Other significant exploratory developments include two recent Cretaceous (Tuscaloosa) discoveries in lightly drilled St. Helena Parish, which had been the only parish in the State of Louisiana that did not have commercial production.

Potential gas resources of approximately 1-1/2 Tcf are estimated to be contained within the 300,000 plus acres of federal lands designated as National Wildlife Reserves where all mineral exploration and development have been formally prohibited.

Table 8 — Area E. South Louisiana and adjacent offshore
(trillion cubic feet)

	Probable	Possible	Speculative
Onshore (Drilling Depth)			
less than 15,000 feet	3	4	—
15,000 to 30,000 feet	3	11	—
Total	6	15	—
Offshore (Water Depth)			
less than 200 meters	20	23	—
200 to 1,000 meters	1	13	—
Total	21	36	—
Area E total	27	51	—

Area G: Texas Gulf Coast and South Texas (RR Comm. Dists. 1, 2, 3 and 4) and Adjacent Offshore

Area G includes south Texas and the Texas Gulf Coast, both onshore and offshore. During the opening of the Gulf of Mexico, tension and stress created a system of faults parallel to the present coast which are downthrown to the Gulf. These faults have continued to move at the same time sedimentation has taken place from the Jurassic Period through modern times and control much of the onshore and some offshore production. Additionally, the northeastern part of the Area falls within the Gulf Coast salt dome basin. Both structural traps and structurally assisted stratigraphic traps are found. Production is largely from upper Mesozoic and Cenozoic rocks, but occurs in rocks as old as Ordovician and as young as Pleistocene.

One of the most important exploration plays at the present time is the Austin Chalk, a Cretaceous limestone. Other major targets are Wilcox sandstones (Eocene) and Frio sandstones (Oligocene). In general, oldest rocks are penetrated and produce most frequently in the northern part of Area G on the flank of the Llano uplift. Southward, toward the Gulf of Mexico, successively younger rocks produce; the exposed sedimentary rocks also are younger in the same direction. None of the area has been severely deformed since formation of the major producing reservoirs.

The estimate of total potential supply for Area G has been reduced by 11 Tcf from the estimate of 12/31/80. This reduction in the estimates consists of 3 Tcf each in the onshore Probable and Possible categories, 4 Tcf in the offshore Probable category and 1 Tcf in the offshore Possible category. There is no change in the estimate of Speculative potential. The changes are a net result of reevaluation of the area where considerable information is now available and transfers of discoveries from potential resources to proved reserves. About two-fifths of the decrease is related to transfers to proved reserves.

The main areas of exploratory and major drilling activity onshore in Area G are the Austin Chalk (Upper Cretaceous) in RR Districts 1 and 3, the Wilcox in Zapata and Duval Counties of RR District 4, the Frio Trend of Districts 2, 3 and 4, the Woodbine-Tuscaloosa activity of District 3 and the promising deep Sligo activity in Districts 1 and 2. Offshore, the Brazos, High Island, Matagorda, and Mustang Island areas continue to lead in significant drilling for Miocene objectives.

Table 9 — Area G. Texas Gulf Coast and South Texas
(RR Comm. Dists. 1, 2, 3 & 4) and adjacent offshore
(trillion cubic feet)

	Probable	Possible	Speculative
Onshore (Drilling Depth)			
less than 15,000 feet	7	9	2
15,000 to 30,000 feet	5	6	2
Total	12	15	4
Offshore (Water Depth)			
less than 200 meters	9	11	—
200 to 1,000 meters	2	5	—
Total	11	16	—
Area G total	23	31	4

Area H: North and South Dakota, Nebraska, Montana, Wyoming, Idaho, Colorado, and Utah

Gas and oil production in Area H is obtained from a diverse group of geologic settings, reservoir ages and environmentally restricted areas. Comprising the states of North and South Dakota, Nebraska, Montana, Idaho, Wyoming, Utah and Colorado, Area H includes sedimentary basins and producing areas of shallow, cratonic rocks as well as deep, geosynclinal provinces. Although many different ages of rocks produce hydrocarbons, Ordovician and Mississippian rocks are the major producers in the Williston basin of North Dakota, eastern Montana and South Dakota, whereas Cretaceous rocks are the most significant gas producers in the Wyoming intermontane basins, the Uinta-Piceance basins of Utah and Colorado, the Denver-Julesburg basin of Colorado, and the San Juan basin of northwestern New Mexico and southwestern Colorado. Most production in the Paradox basin of southeastern Utah is from rocks of Pennsylvanian age. Production from the Western Thrust Belt in Wyoming and Utah ranges from Cretaceous oil production to Mississippian and Devonian gas-condensate production.

The Williston basin is known more for its oil production than gas; however, in the past four years, significant new gas discoveries in the Ordovician Red River and the Winnipeg Formations in the deeper parts of the basin have demonstrated that there are significant resources of gas yet to be discovered there. This basin is particularly significant for the Rocky Mountain province because its producing rocks are mostly limestones and dolomites, rather than sandstones. A few reefs are known in the basin, but these do not contribute significant gas production.

The southern part of the Alberta basin extends into Montana. It has gas production from Cretaceous and Jurassic rocks, particularly in the Bowdoin dome area, but also around the Bearpaw uplift and the Sweetgrass arch to the west.

Production from the Denver-Julesburg basin is largely from Cretaceous rocks in the western part of this asymmetric, yoked basin. The basin is faulted down against the Front Range of the southern Rocky Mountains and gently rises to the east (Nebraska and Kansas). Extensive drilling has proven that the tight limestones (chalks) of the Niobrara Formation (Cretaceous) in the eastern part of the basin will add significant reserves to the natural gas supply. Drilling in the Denver basin for Paleozoic sandstones and carbonates is sparse. Further exploration of Paleozoic-age reservoirs may result in the discovery of additional fields similar to Amazon field in southwestern Nebraska, which produces oil from a Pennsylvanian-age carbonate section.

Powder River basin exploratory activity has continued at high levels, particularly for targets of Cretaceous and Permian ages. Modern remote-sensing concepts, sophisticated stratigraphic-seismic techniques and newer structural theories, coupled with increased drilling in the northern half of the basin, should provide significant new reserves, primarily of oil.

Other intermontane basins of Wyoming, such as the Green River, Big Horn and Wind River, produce large quantities of gas from Cretaceous and early Cenozoic rocks, with deeper horizons showing much promise. However, the drilling depths of over 20,000 feet so far have precluded detailed evaluation of deep reservoirs. Along mountain fronts, steep "ramp" thrust faulting has created the potential for large accumulations of gas, but exploration is extremely expensive and risky. The

Uinta and Piceance basins are similar, in some respects, to the Wyoming basins, and extensive reserves of gas are being developed there in low-permeability ("tight") sandstones of Cretaceous age.

Perhaps the most exciting portion currently of Area H from an exploration standpoint is the Western Thrust Belt or Overthrust Belt. This really is a series of at least three separate structural provinces, each characterized by a very thick sedimentary rock section that has been broken into slabs. These slabs have been stacked and thrust so that wells may penetrate individual rock units several times during drilling. Production is generally from structures buried under one or more of these slabs or thrust sheets. Exploration in the Central, or Middle, Thrust Belt (western Wyoming and northeastern Utah) has encountered prolific gas resources. The Southern Thrust Belt (central Utah and southeastern Nevada) so far has not been found productive. In the Northern Thrust Belt, or Disturbed Belt, of northeastern Montana, potentially significant gas reserves are being developed in Mississippian-age carbonate rocks. While most geologic factors are favorable to hydrocarbon accumulations, extreme technical difficulties in mapping subsurface rocks, coupled with high temperature gradients, make this province extremely high-risk for drilling at this time.

All of Area H is subject to stringent environmental restrictions, because the area includes much of the Rocky Mountain province. In many areas, such as the Thrust Belt, exploration activity is destined to take place in the most scenic parts of the American West. If petroleum exploration is to continue, and even to expand, in these environmentally sensitive mountainous areas, more attention must be given to the mitigation of the environmental impacts of such operations.

Estimates of the natural gas potential for Area H have been increased from the 12/31/80 figures by 9 Tcf in the Probable category and 15 Tcf in the Possible category and decreased by 3 Tcf in the Speculative category. Overall, the new estimates for Area H show a net increase of 21 Tcf.

For the first time, this biennial report includes estimates of the percentages of the potential supply of natural gas in each category that are believed to lie in low-permeability, or "tight", reservoirs. More than half of the estimated potential Probable and Speculative supply of natural gas in Area H is believed to be in the "tight" category (table 16).

Changes in the Probable and Possible potential supply of natural gas throughout Area H have resulted primarily from data provided by new, generally deep (greater than 15,000 feet), discoveries in the Williston, Green River, Wind River, and Piceance Creek basins and in the Central Thrust Belt. Decreases in the Speculative category resulted from re-evaluations of certain areas in Montana and in the Powder River and Green River basins.

In Montana (exclusive of the Williston basin), the total potential resources (in all three categories) have been decreased approximately 4 Tcf due to the fact that few significant gas discoveries have been made in recent years, with the exception of the Western Montana Disturbed Belt (or Northern Thrust Belt), where gas has been discovered in faulted Mississippian carbonate rocks.

In the Williston basin, the total potential resources have been increased by approximately 1 Tcf in the Probable category as a result of the discovery of gas in the Ordovician Red River and Winnipeg Formations at depths ranging from approximately 11,500 feet to more than 14,000 feet.

Wind River basin Possible resources have been increased by approximately 4 Tcf due to a significant discovery of gas on the eastern margin of the basin in subthrust Cretaceous sediments below 18,000 feet. This well, which drilled through a wedge of Percambrian granite nearly 9,000 feet thick, marks the first commercial discovery in the region beneath a mountain-front thrust sheet.

In the Greater Green River basin, estimated total potential resources have been increased by approximately 16 Tcf in the combined Probable and Possible categories as a result of including, for the first time, the methane fraction (approximately 22%) contained in low-Btu gas that is known to occur below 15,000 feet in Paleozoic-age reservoirs in the Big Piney-La Barge area, in the western part of the basin. Potential resources in Cretaceous-age reservoirs in both major depth categories have been reduced somewhat due to poorer than expected performance of such wells, especially at depths below approximately 12,000 feet.

The methane fraction (about 22%) in the low-Btu gas estimated for the Big Piney-La Barge area (or Moxa arch), in both the western Green River basin and Central Thrust Belt blocks, ranges from a minimum of 16 Tcf to a maximum of 52 Tcf, with 31 Tcf being the most likely figure. Recent deep discoveries have found high flow rates of low-Btu gas from the Permian Phosphoria, Pennsylvanian Weber, Mississippian Madison and Ordovician Big Horn Formations.

In the Central Thrust Belt (or Wyoming-Utah-Idaho Overthrust Belt), estimated total potential resources have been increased by a net 5 Tcf in the Probable category as a result of counting the methane content of low-Btu gas for the first time. In the Speculative category, at least 50 percent of the natural gas resources (43 Tcf) expected to be found in Cretaceous-age clastic reservoirs probably will be classified as "tight" gas.

Deep exploration in the Big Horn, Powder River, Uinta, and Piceance Creek basins has resulted in little or no increase in potential resources estimated for any of the categories. Potential resources in the Denver basin, in western Nebraska and in southeastern Colorado, have been slightly increased in all three categories as a result of new discoveries in both Cretaceous and Permo-Pennsylvanian sequences, all at depths less than 15, 000 feet. In the Paradox basin, small decreases have been recorded for both the Possible and Speculative categories. For the first time, potential resources (Speculative) have been estimated for Idaho (exclusive of the Central Thrust Belt), in the Snake River downwarp.

Drilling to depths in excess of 15,000 feet in the deeper Rocky Mountain sedimentary basins has increased significantly in the past two years in provinces such as the Central Thrust Belt, in the Big Horn, Powder River, Wind River, Green River and Piceance Creek basins and along the Southern Thrust Belt (or "Hingeline") in west-central Utah. A drilling well in the eastern Wind River basin is projected to a total depth of 26,500 feet, which should establish a record for the Rockies. Two-thirds of the 61 "deep" wells drilled in Area H during 1981 were successful. Most of the gas produced from clastic reservoirs at these depths, no doubt, will be classed as "tight" gas following current Federal Energy Regulatory Commission definition.

Perhaps as much as 50 percent of the mountainous flanks of several of the petroliferous Rocky Mountain basins and associated uplifts either have been formally withdrawn or presently are unavailable for energy resource exploration and development as a result of environmental sensitivities or restrictions. In scenic areas such as the Southern, Central and Northern Thrust Belts, a significant percentage of the estimated potential gas supply thus may be legally unavailable.

Table 10 — Area H. Northern Rocky Mountains
North and South Dakota, Nebraska, Montana, Wyoming, Idaho, Colorado, and Utah
(trillion cubic feet)

	Probable	Possible	Speculative
Onshore (Drilling Depth)			
less than 15,000 feet	29	37	26
15,000 to 30,000 feet	20	56	40
Area H total	49	93	66

Area I: Arizona and New Mexico

Producing areas of Area I include the San Juan basin which extends from northern New Mexico into southwestern Colorado and the Defiance uplift of northeastern Arizona. The Defiance uplift has been disappointing in its success; its most important field produces from fractured igneous rock. However, the San Juan basin is a major gas-producing basin which is now receiving new emphasis for oil production as well.

Structurally allied with the Colorado Plateau province, the San Juan basin received marine and non-marine sedimentation during Cretaceous time with organic shales and some carbonates being intercalated with sandstone wedges derived from erosion of the early western Rocky Mountain uplift.

Gas is produced from Upper Cretaceous sandstones, primarily associated with the Pictured Cliffs Sandstone, the Mesaverde Group and the Dakota Group, while oil is produced more commonly from the Upper Cretaceous Gallup Sandstone. Deep drilling is sparse, but there may be resource potential in Jurassic sandstones and possibly in Pennsylvanian carbonates. High drilling density and production in the shallower Cretaceous rocks precludes effective deeper exploration until present reserves are depleted.

Two other major tectonic provinces exist in Area I that have had recent, albeit unsuccessful, attention. The Rio Grande rift system is an active tectonic zone which may have geothermal potential. Southern Arizona is part of the Basin and Range Province which has been suggested as a southern extension of the Western Thrust Belt. No successful exploration attempts have been recorded despite some very interesting attempts to validate the overthrust hypothesis by penetrations through Precambrian crystalline rocks.

There has been no significant change in the estimate of resource potential of Area I since the 1980 report. Except for some peripheral San Juan basin area drilling, the exploratory activity has been sporadic and disappointing across Area I.

Current activity, although meager, is primarily limited to a few shallow, scattered exploratory tests in Arizona. It is believed there will be continued, but limited, activity in the possible "Overthrust Belt" in southern Arizona.

Table 11 — Area I. Southern Rocky Mountains
Arizona and New Mexico
(trillion cubic feet)

	Probable	Possible	Speculative
Onshore (Drilling Depth)			
less than 15,000 feet	2	3	1
15,000 to 30,000 feet	—	—	—
Area I total	2	3	1

Area J-North: Mid-Continent Kansas, Oklahoma, and Texas RR Comm. Dist. 10

Production of oil and gas in Area J-North is from several geologic provinces including the western Arkoma basin, Anadarko basin, Hugoton embayment, central Oklahoma region, Central Kansas uplift, Nemaha ridge, Salina basin, and Forest City basin.

With the exception of the Anadarko basin, these geologic provinces are characterized by relatively thin sedimentary units covering large areas with many broad structures. The province is tectonically well up on the continental plate and unaffected by large orogenic movements, although vertical uplifts are common. Rocks that produce hydrocarbons range from Cambrian to Permian in age.

Stratigraphic traps in Pennsylvanian sandstones have been very important in the Anadarko basin. Much of the sandstone of Pennsylvanian age is associated with uplift of fault blocks during late Mississipian and Pennsylvanian time to form parts of the Ancestral Rocky Mountains and parts of the Ouachita fold and thrust belt. Detritus from these uplifts as well as cratonic drainage has created numerous potential hydrocarbon reservoirs and helped create the source rocks for some of them. Earlier Paleozoic reservoirs are largely cratonic sedimentary rocks, excluding both mudstones and limestones. Pennsylvanian limestones are important producing reservoirs in Kansas where these rocks are cyclic in nature.

In the deformed areas of the Anadarko basin and adjacent areas, production is also from Paleozoic rocks, but faulted structures are important to accumulations. Thermal gradients have been higher than in the shallower areas with consequently higher gas-oil ratios and greater overall hydrocarbon potential.

The estimates of potential supply above 15,000 feet in Area J-North have decreased by 3 Tcf in the Probable category and by 5 Tcf in the Possible category, while the estimate for the Speculative category remains unchanged since the estimates for 12/31/80. Approximately one-half of the decrease is due to transfers from potential supply to proved reserves.

Below 15,000 feet the estimates of potential supply have decreased by 1 Tcf in the Possible category and by 3 Tcf in the Speculative category, while the estimate for the Probable category has remained unchanged since the 12/31/80 estimates. Approximately one-third of the decrease is due to reserve additions that were removed from potential supply during the two-year period.

The record amount of drilling activity seen in Area J-North in the past two years has helped evaluate several areas and several drilling target horizons. There were major disappointments in some areas such as the deep Pennsylvanian Springer sands in the Cyril sub-basin of the southeastern Anadarko basin in Oklahoma, but significant discoveries were made in all parts of the Area to give justification to the estimates made for most other areas. By 12/31/82 there had been a marked decrease in the amount of drilling activity in Area J-North compared to what was seen a year earlier, but the activity in 1982 would still rank within the top three years for most parts of the area.

Oklahoma established a new producing depth record in a recent completion from the Hunton Formation (Siluro-Devonian) in Beckham County. The well flowed over 14 million cubic feet of gas per day from below 24,928 feet.

The portion of resource not currently available for exploration and production due to environmental restrictions or withdrawals from exploration within Area J-North is insignificant.

Table 12 — Area J-North. Mid-Continent
Kansas, Oklahoma, and Texas RR Comm. Dist. 10
(trillion cubic feet)

Onshore (Drilling Depth)	Probable	Possible	Speculative
less than 15,000 feet	15	22	5
15,000 to 30,000 feet	9	38	34
Area J-North total	24	60	39

Area J-South: Permian Basin S.E. New Mexico (Chaves, Eddy, Lea & Roosevelt Cos.) and Texas RR Comm. Dists. 7C, 8 & 8A

Area J-South comprises the world-famous Permian basin. Although production is from rocks as old as Ordovician, the major oil and gas production from this region is associated with Pennsylvanian and Permian carbonates that formed an extensive complex of organic reefs and reef-associated environments.

Thick sections of early Paleozoic rocks were accumulated along the Continental Shelf, including potential source rocks. During the Appalachian-Ouachita-Marathon-Ancestral Rocky Mountains orogenic episode that deformed much of the United States' cratonic margin in late Paleozoic time, structural reversal and development of basins and platforms occurred in the Permian basin region, which is mountain-bounded on the north by the Matador uplift and on the northwest and west by the Pedernal uplift. As these uplifts were eroded, their detritus was spread into the basins while carbonate deposition was occurring simultaneously on isolated platforms. Eventually much of Area J-South was covered by shallow marine carbonates or nearshore clastics.

The reefs that developed along platform edges, the detritus that spilled into the basins, older rocks with structural trapping factors, and nearshore sedimentary rocks with stratigraphic hydrocarbon accumulations have all contributed to the production of the area. Although more potential hydrocarbons exist, this area is reaching maturity as an exploration area.

The estimates of the potential gas resource for Area J-South have been reduced in the Probable and Possible categories. Estimates of Probable resources at depths less than 15,000 feet have been revised downward 1 Tcf from 8 Tcf to 7 Tcf. The estimates of Possible resources at depths from 15,000 to 30,000 feet were reduced 1 Tcf from 15 Tcf to 14 Tcf. Resource estimates for the remaining categories were unchanged. All of this decrease can be accounted for by transfers from potential resources to proved reserves.

The Delaware basin is one of the primary exploratory areas in west Texas and the center of activity has been Loving County. Operators were drilling deeper to find new reserves during 1981 and 1982. Two depth records, one for drilling and one for production, were set by wells in the Delaware basin.

There has been exploration activity in the oil and gas frontier areas of the Permian basin. These areas include the Ouachita-Marathon folded belt in Presidio, Brewster, Pecos and Terrell Counties in west Texas and the Abo reef play in Chaves County, New Mexico, where some significant discoveries were made. Other areas include the Laramide folded belt in El Paso and Hudspeth Counties, Texas and the Marfa basin in Presidio, Jeff Davis and Brewster Counties. The Abo sands gas play in Chaves County, New Mexico has slowed due to a decrease in gas demand and the unsuccessful extension of production into Guadalupe and De Baca Counties. These and other frontier exploration areas will probably continue to attract seismic work and drilling in the future.

Table 13 — Area J-South. Permian Basin
(S.E. New Mexico, Chaves, Eddy, Lea & Roosevelt Cos.
and Texas RR Comm. Dists. 7C, 8 & 8A)
(trillion cubic feet)

Onshore (Drilling Depth)	Probable	Possible	Speculative
less than 15,000 feet	7	19	1
15,000 to 30,000 feet	8	14	—
Area J-South total	15	33	1

Area K: Alaska and Adjacent Offshore

Alaska has both production and potential; nowhere else is the hydrocarbon potential quite so high and land accessibility and environmental issues so large a problem. Alaska is a vast frontier area with 357 million acres on land and another 380 million acres between the shoreline and the 1,000-meter water depth. Only two areas have established oil production at the present time, the Cook Inlet basin west and southwest of Anchorage, and the North Slope. Only the Cook Inlet basin has gas production. One major problem for development of the natural gas resources of Alaska has been finding accumulations which are sufficiently large to justify completion and development of pipeline systems.

Alaska encompasses parts of the Rocky Mountain and Western North American Borderland tectonic and stratigraphic setting. Sedimentary rocks that produce or are considered prospective producing intervals are Paleozoic or younger. Structures are both folded and faulted. Reservoir rocks are variable lithologies from sandstones to carbonates.

Alaska is still in a frontier mode, but there are better interpretations now about both limits and potentials. Recent seismic work and wildcat drilling have diminished what was earlier considered to be prospective acreage, for example, portions of the Gulf of Alaska and the Lower Cook Inlet. Negative results of exploratory activity in the Kodiak and Yakataga areas have also resulted in reduction of estimates of potential gas resources. The only post-1975 wildcats drilled in the National Petroleum Reserve-Alaska (NPRA) were drilled by the U.S. Geological Survey. The NPRA is considered to contain potential for development of gas resources. There are a number of large areas like the Bering Sea, Arctic Wildlife Refuge, Norton basin and Chukchi Sea that, as yet, have not been explored for oil or gas. These frontier areas hold unknown hydrocarbon potential as could portions of such already partially drilled areas as the Arctic and Cook Inlet basins.

Estimates of the Probable and Possible resources for Alaska remain the same in 1982 as for 1980. However, there has been a reduction of 11 Tcf in the estimate of Speculative resources. This reduction is due largely to better definition of the basins in the Bering Sea area. Recent work has shown that these are continental margin basins and are more limited in areal extent than previously considered. These recent data have, therefore, caused Committee members to be less optimistic about the resources of the total Bering Sea area.

Portions of the Arctic National Wildlife Refuge are looked upon by industry as among the more promising areas in Alaska with respect to prospects for future oil and gas resources. Because of limitations on available data for the Wildlife Refuge and present restrictions on exploration activities, the magnitude of the potential natural gas resource is not yet clearly known. Federal guidelines for exploration and development are not likely before 1986. Therefore, the timing of lease offerings is uncertain.

A better understanding of some of the frontier areas hopefully may be developed through exploration and drilling in the next several years. Areas in which there is present and planned exploration and drilling include the Norton basin, the St. George basin, the Navarin basin, the Lower Cook Inlet, and the Yakutat block in the eastern Gulf of Alaska. Active drilling is presently going on in the Yakutat block. Drilling should commence within one or two years in the St. George basin, the Norton basin, and the Lower Cook Inlet.

Table 14 — Area K. Alaska and adjacent offshore
(trillion cubic feet)

	Probable	Possible	Speculative
Onshore (Drilling Depth)			
less than 15,000 feet	6	16	28
15,000 to 30,000 feet	—	—	—
Total	6	16	28
Offshore (Water Depth)			
less than 200 meters	2	13	59
200 to 1,000 meters	—	—	10
Total	2	13	69
Area K total	8	29	97

Area L: California, Nevada, Pacific Northwest (excluding Idaho), and Adjacent Offshore

Area L includes the Pacific Coast states, onshore and offshore, and the State of Nevada. Onshore, major production comes from the Great Valley, but onshore portions of the Ventura basin and the Los Angeles basin are also quite important. Elsewhere, Area L has seen exploration and recently developed production in northwest Oregon in the Astoria-Nehalem basin. Other parts of Oregon and Washington have been the sites of increased exploration, but no production has been established. There is limited oil production from Nevada, but no significant gas production. The principal sedimentary basins which have been the sites of exploration and production are all located in California and include the largely gas-prone Sacramento basin which lies in the northern part of the Great Valley as well as the more oil-prone San Joaquin basin (southern part of the Great Valley), Ventura and other coastal basins, Los Angeles basin and the offshore areas.

During Mesozoic time orogenic deformation of the west coast of North America formed chains of volcanos and fault-block basins and floods of both clastic and volcanic sediments were deposited on what became much of Area L. Later tectonic activity and subsequent erosion formed a complex of faulted mountain ranges and deep valleys which comprise Nevada and southern Arizona.

The California basins received thick accumulations of sediments during Cretaceous and Tertiary time which were deposited in deep to shallow marine environments and which contained abundant organic remains which have been converted to hydrocarbons. Surface seepage of these hydrocarbons controlled early exploration programs. California production, offshore and onshore, comes mostly from Cenozoic sandstones associated with traps that are structurally complex.

There was a decrease in the estimates of potential supply in all categories for the onshore portion of Area L. The primary reason for this decrease was a re-evaluation of the estimate for the San Joaquin Valley. Since the first report was made in 1966, the estimates for the San Joaquin Valley have been high, relative to other portions of Area L, and the results of deeper drilling in the past 16 years have been a disappointment in the San Joaquin Valley. Since gas production in the San Joaquin Valley has been dominantly associated gas, the former potential supply estimates would have required discovery of oil in quantities that now seem unreasonably high for this basin.

Exploration for natural gas in the onshore portion of Area L continued at relatively low levels except for the Sacramento Valley where many extensions and smaller new field discoveries were made in the past two years, but no new fields of significant size were discovered. Renewed interest in developing production from the lenticular sands in the Forbes Formation has met with success in many areas of the Sacramento basin. Many productive horizons and a wide range of trapping mechanisms continue to make the Sacramento Valley an attractive area for exploration, though activity in 1982 was down slightly from 1981.

In the San Joaquin Valley, associated gas from the new field discovery at Tulare Lake and from many smaller developments in the Stevens sands in Kern County have been the most significant events in that basin for the past two years.

In the Ventura-Coastal areas of onshore California, there were several extensions and a new field discovery at Los Alamos giving this area a better rate of success than that seen in recent years; the gas is solution gas in association with oil production.

Two new gas pools for the Mist Field in Oregon and subcommercial quantities of gas from two wells in Washington continue to give encouragement for continued exploration in the Pacific Northwest, though results during the past two years have not measured up to the high level of optimism that existed after the initial discovery of gas at Mist in 1979.

Offshore activity increased significantly over the previous two-year period. Central California OCS Sale #53 was held in May 1981 and Southern California OCS Sale #68 was held in June 1982. High bids on 251 tracts offered totaled 2.43 billion dollars. Sale #53 was marked as having the largest bonus ever offered in the United States for one tract, 33.6 million dollars. OCS Sale #73, Central and Northern California, is scheduled for late 1983.

Discovery of a major oil field off Point Arguello in the southern Santa Maria area was announced. Additional new pool discoveries were also announced in the Santa Barbara Channel area. Considerable drilling activity is underway in the Santa Maria-Point Arguello area and the State of California has announced a sale in late 1983, the first state sale since 1968. The Probable and Possible resource category estimates increased as a result of the discoveries near Point Arguello.

Table 15 — Area L. California, Nevada, Pacific Northwest
and adjacent offshore
(trillion cubic feet)

	Probable	Possible	Speculative
Onshore (Drilling Depth)			
less than 15,000 feet	1	6	7
15,000 to 30,000 feet	1	2	1
Total	2	8	8
Offshore (Water Depth)			
less than 200 meters	—	5	4
200 to 1,000 meters	—	4	5
Total	—	9	9
Area L total	2	17	17

Natural Gas From Low Permeability Formations

For this report, members of the Area Work Committees of the Potential Gas Committee were asked to estimate the quantity of potential gas resources which might exist in formations which have **in-situ** permeabilities to natural gas of less than 0.1 millidarcy and which are included in the Committee's overall resource assessments. In order to make the estimates of "tight" formation resources, Committee members relied on extrapolation of known formation characteristics from current producing areas, on permeability data from cores taken in wildcat wells outside current producing areas, and on analogy of prospective regions to explored regions. Because of the many uncertainties involved in extrapolation of formation characteristics to unexplored provinces and depths, the estimates of the resource contained in low permeability formations are subject to considerable uncertainty. Therefore, the estimates presented in table 16 are to be considered only as approximate but representing the magnitude of the resource. All estimates are presented as percentages of the total resource potential. No resources from low permeability formations are included in the estimates for offshore areas or for Area K (Alaska).

In Retrospect and Prospect

As for all resources occurring in the crust of the earth, the absolute volume of natural gas ultimately recoverable is a specific but unknown quantity. It should be recognized that changes in estimates of the potential supplies from time to time do not actually increase or decrease the ultimately recoverable volume. Such changes reflect improvements in estimating techniques and increased basic knowledge of the occurrence of natural gas at the time of the estimate. It must also be recognized that any estimate of potential supply lacks the accuracy of the estimates of proved recoverable reserves.

Economic, technological and governmental factors do not change the absolute volume of ultimately recoverable natural gas. Such factors, however, do influence the estimates of the potential supply in that they may increase or decrease the amount of gas which the estimator feels are within the limits of economic and technological feasibility. These factors may further influence the timing and rate of development of natural gas resources.

In each succeeding study by the Potential Gas Committee, the impact of new technology has been considered. In the first study of 1964, offshore drilling was limited to

Table 16 — Potential natural gas resources in tight formations

Estimated percentage of natural gas potential occurring in formations
with less than 0.1 millidarcy relative permeability to gas

	PROBABLE				POSSIBLE				SPECULATIVE			
	0 - 15,000 ft.		15,000 - 30,000 ft.		0 - 15,000 ft.		15,000 - 30,000 ft.		0 - 15,000 ft.		15,000 - 30,000 ft.	
AREA - Onshore	Total Potential (Tcf)	Amount in Tight Fms. (%)	Total Potential (Tcf)	Amount in Tight Fms. (%)	Total Potential (Tcf)	Amount in Tight Fms. (%)	Total Potential (Tcf)	Amount in Tight Fms. (%)	Total Potential (Tcf)	Amount in Tight Fms. (%)	Total Potential (Tcf)	Amount in Tight Fms. (%)
A	27	87%	—	—	8	5%	—	—	22	—	11	—
B	4	8%	2	9%	3	8%	3	10%	3	10%	4	12%
C	—	—	—	—	2	—	—	—	1	—	—	—
D	8	10%	—	—	20	15%	—	—	15	20%	4	20%
E	3	—	3	—	4	—	11	—	—	—	—	—
G	7	4%	5	6%	9	6%	6	8%	2	6%	2	8%
H	29	75%	20	25%	37	39%	56	26%	26	27%	40	73%
I	2	47%	—	—	3	11%	—	—	1	—	—	—
J-North	15	—	9	22%	22	5%	38	37%	5	60%	34	59%
J-South	7	7%	8	—	19	2%	14	—	1	—	—	—
L	1	4%	1	30%	6	5%	2	30%	7	10%	1	40%
Total Onshore Lower 48 States	151 Tcf 37%				263 Tcf 19%				179 Tcf 36%			

water depths of 300 feet. In 1966, this limit was increased to 600 feet, and in 1968, the water depth was increased further to 1,500 feet. Drilling depths were increased also, from 25,000 to 30,000 feet, in the 1968 report. The parameters of maximum drilling depth of 30,000 feet and 1,500 feet water depth were used for the 1970, 1972, and 1976 reports. The parameters for the 1978, 1980, and 1982 publications retain the onshore maximum drilling depth of 30,000 feet. In offshore areas, separate estimates are made for resource potential existing beneath water depths of 0 to 200 meters (656 feet) and 200 to 1,000 meters (3,281 feet). All potential supply estimates represent most likely volumes. The effects of newly developed technology will continue to be considered in future studies.

Table 17 summarizes the estimates of potential supply which have been given in each of the Potential Gas Committee reports.

Table 17 — Comparison of estimates of potential supply of natural gas from Potential Gas Committee reports (trillions of cubic feet at 14.73 psia and 60° F.)

	Probable	Possible	Speculative	Total
Lower 48 States				
As of 12-31-66	300	210	180	690
As of 12-31-68	238	317	245	800
As of 12-31-70	218	326	307	851
As of 12-31-72	212	290	278	780
As of 12-31-76	192	318	188 to 238	698 to 748
As of 12-31-78	186	359	285	830
As of 12-31-80	185	329	254	768
As of 12-31-82	184	326	232	742
Total United States (including Alaska)				
As of 12-31-68	260	335	632	1,227
As of 12-31-70	257	387	534	1,178
As of 12-31-72	266	384	496	1,146
As of 12-31-76	215	363	345 to 395	923 to 973
As of 12-31-78	199	399	421	1,019
As of 12-31-80	193	358	362	913
As of 12-31-82	192	355	329	876

Table 18 — Estimated potential supply of natural gas
in United States as of December 31, 1982
Onshore, 0-15,000 feet drilling depth
(trillions of cubic feet at 14.73 psia and 60° F.)

Area	Probable	Possible	Speculative
A	27	8	22
B	4	3	3
C	—	2	1
D	8	20	15
E	3	4	—
G	7	9	2
H	29	37	26
I	2	3	1
J-North	15	22	5
J-South	7	19	1
L	1	6	7
48 States Subtotal	103	133	83
K Alaska	6	16	28
Total less than 15,000 feet Drilling Depth Onshore United States	109	149	111

Table 19 — Estimated potential supply of natural gas
in United States as of December 31, 1982
Onshore, 15,000-30,000 feet drilling depth
(trillions of cubic feet at 14.73 psia and 60° F.)

Area	Probable	Possible	Speculative
A	—	—	11
B	2	3	4
C	—	—	—
D	—	—	4
E	3	11	—
G	5	6	2
H	20	56	40
I	—	—	—
J-North	9	38	34
J-South	8	14	—
L	1	2	1
48 States Subtotal	48	130	96
K Alaska	—	—	—
Total 15,000 to 30,000 feet Drilling Depth Onshore United States	48	130	96

Table 20 — Estimated potential supply of natural gas in United States as of December 31, 1982

Offshore, 0-200 meters water depth
(trillions of cubic feet at 14.73 psia and 60° F.)

Area	Probable	Possible	Speculative
A	—	—	11
B	1	2	15
C	—	—	—
D	—	—	—
E	20	23	—
G	9	11	—
H	—	—	—
I	—	—	—
J-North	—	—	—
J-South	—	—	—
L	—	5	4
48 States Subtotal	30	41	30
K Alaska	2	13	59
Total less than 200 meters Water Depth Offshore United States	32	54	89

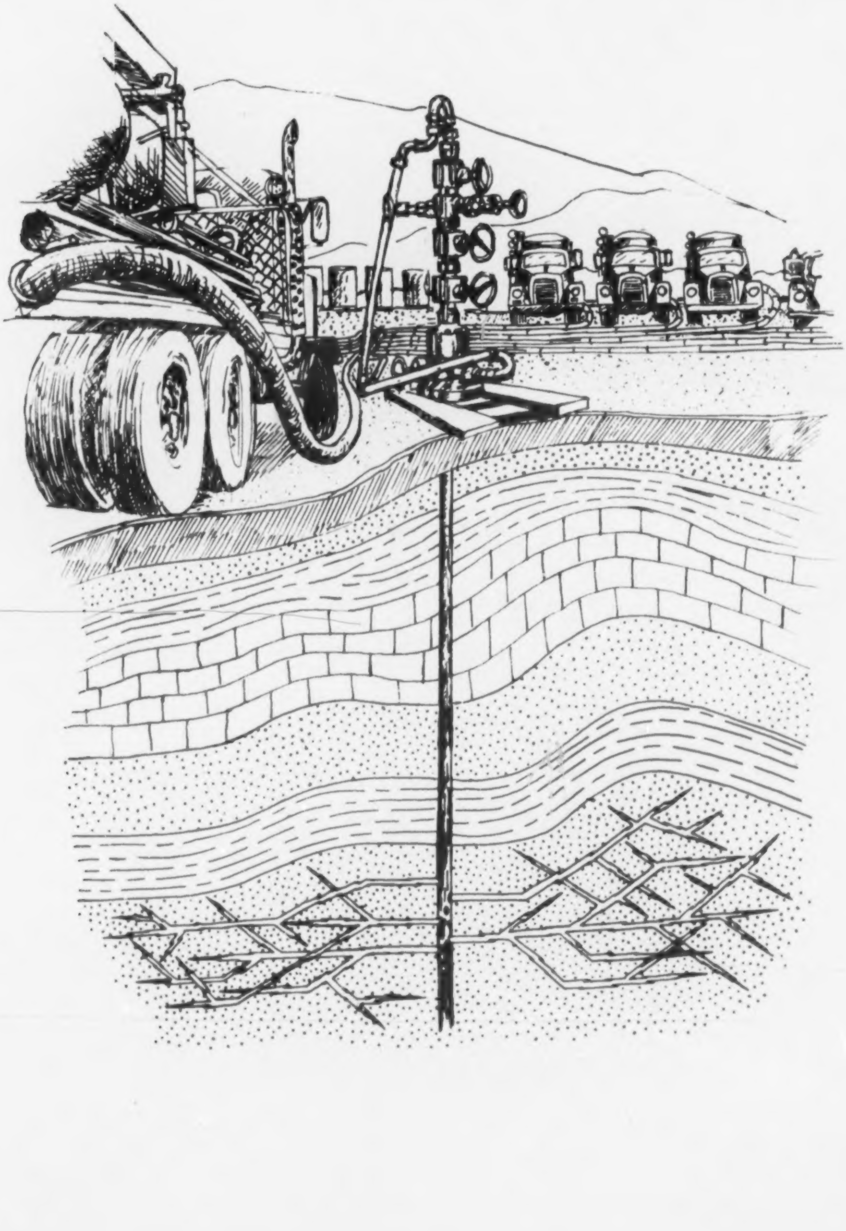
Table 21 — Estimated potential supply of natural gas in United States as of December 31, 1982

Offshore, 200-1,000 meters water depth
(trillions of cubic feet at 14.73 psia and 60° F.)

Area	Probable	Possible	Speculative
A	—	—	5
B	—	—	13
C	—	—	—
D	—	—	—
E	1	13	—
G	2	5	—
H	—	—	—
I	—	—	—
J-North	—	—	—
J-South	—	—	—
L	—	4	5
48 States Subtotal	3	22	23
K Alaska	—	—	10
Total 200 to 1,000 meters Water Depth Offshore United States	3	22	33

PART II

REPORT OF THE POTENTIAL GAS AGENCY



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REPORT OF THE POTENTIAL GAS AGENCY

Evaluation by Potential Gas Agency

—Harry C. Kent, Director
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The accompanying report by the Potential Gas Committee (PGC) is the ninth estimate of the potential supply of natural gas in the United States made by the Committee and the eighth published by the Potential Gas Agency (PGA) of the Colorado School of Mines. The estimates contained in this report have been prepared by members of the Potential Gas Committee working through their Area Work Committees and reviewed at the regional and national level by the entire Potential Gas Committee. The Potential Gas Agency has acted to guide and assist the work of the Potential Gas Committee and to assure that professional standards and objectivity were maintained during the preparation of the estimates.

DUTIES AND RESPONSIBILITIES OF POTENTIAL GAS AGENCY

The Potential Gas Agency is charged with approving the criteria and methods used by the Potential Gas Committee and insuring that these are followed and maintained in preparing estimates and reports; the object being to maintain the highest scientific standards and objectivity. The Agency also acts to assure that there is an adequate representation of qualified personnel from many different segments of the natural gas industry and governmental and academic sectors. The Agency appoints the Chairman and Regional Vice Chairmen of the Potential Gas Committee and approves the appointment of other members to the Committee.

The Agency is sponsored by the American Gas Association through a grant to the Colorado School of Mines. The School of Mines, in turn, is responsible for selecting the Director and other personnel of the Agency and conducting the affairs of the Agency in a professional manner. Guidance for the PGA is provided by the Gas Supply Committee of the American Gas Association, which is responsible for the setting of general policy and objectives and financing of the study.

ORGANIZATION AND OPERATION OF POTENTIAL GAS COMMITTEE

There is no direct link between the Gas Supply Committee of the American Gas Association and the Potential Gas Committee. All contact is through the Potential Gas Agency. One of the duties of the Agency is to see that separation is maintained. The significance of this separation is that the Gas Supply Committee does not, in any way, enter into the deliberations nor influence the estimates which are prepared by the PGC.

Membership of the Potential Gas Committee is drawn from both large and small exploration and production companies, consultants, state geological surveys and academic institutions. Most of the members are geologists and engineers. Observers from a number of Federal agencies and various associations are also included in the Committee membership. For administrative purposes, the United States is divided into three regions (East, Central and West) and into 12 Work Areas. Each of the Work Areas has a Chairman, whose appointment must be approved by the Potential Gas Agency, and who reports to a Regional Vice Chairman. The Area Work Committees must also include at least one representative each from the pipeline and distribution segments of the natural gas industry in order to assure broad representation of all interests.

Each Area Work Committee functions independently. Its members are charged with gathering all available information about the geology and occurrence of natural gas in the assigned area. The members review past exploration and production history and, based on the historic record and their collective geological and operating expertise, evaluate the potential for further discoveries in both partially explored and unexplored basins.

The procedures for arriving at the estimates of potential supply are outlined in detail in Part I of this report. The

Director and other staff members of the Potential Gas Agency have met with Area Work Committees and have observed their operation. It is the conclusion of the Agency that the Area Work Committees have followed the standards adopted by the Potential Gas Committee, as outlined in Part I, in preparing their estimates.

Because of the nature of the work involved, it is not always possible to achieve complete uniformity in the work of all of the Area Committees. In some areas, there is a great deal of geologic knowledge and the area is in a reasonably mature stage of exploration. In other areas, exploration has only begun and there is relatively little basic geologic information. In spite of these differences, in the opinion of the Potential Gas Agency, the work of the Committee has been conducted in a sound and scientific manner.

Although the only way in which the estimates of the Committee can be proved or tested is by drilling prospective areas, the variety of background of individuals working on the Committee and the discussion and review which have occurred at both the area and national levels have resulted in a consensus. Over the past 19 years, several hundred qualified professionals have participated in the work of the Potential Gas Committee. The consistency of the results of these investigations within the parameters set by the Committee is notable. Although there may be differences of opinion as to the potential in limited local areas or basins, the resulting figures are reasonable estimates when reported as composite figures for Potential Gas Committee reporting areas.

REVIEW OF PROVED RESERVES AND POTENTIAL SUPPLY

As emphasized in the report of the Potential Gas Committee, the estimates presented by this Committee are of potential supply which is in addition to proved reserves. In order to gain a total perspective of the potential ultimately recoverable volume of natural gas in the United States, it is necessary to consider the total of cumulative past production, present proved reserves, and future supply. Cumulative natural gas production for each of the PGC reporting areas, taken from the published report of the Office of Oil and Gas, Energy Information Administration, U.S. Department of Energy as of December 31, 1981, is shown in figure 16. Also shown in figure 16 are estimates of proved natural gas reserves for each of the Potential Gas Committee reporting areas, based on estimates published by the U.S. Department of Energy, December 31, 1981. Estimates of cumulative production and proved reserves for year-end 1982 are not available at the date of publication.

The report of December 31, 1979 prepared by the Committee on Natural Gas Reserves of the American Gas Association was the last report prepared by that committee following the procedures of past years and published jointly with reports of the American Petroleum Institute and the Canadian Petroleum Association. In February 1980, the first of a new series of reports on U.S. Crude Oil and Natural Gas Reserves was issued by the Office of Oil and Gas Information System, Energy Information Administration, U.S. Department of Energy. This report compiled estimates of U.S. proved reserves of crude oil and natural gas based on data submitted to the Department by selected oil and gas well operators as of December 31, 1977. Subsequent reports cover the years 1979, 1980 and 1981. This series of reports by the Department of Energy replaces the reports of the American Gas Association and the American Petroleum Institute.

All subsequent comparisons between the PGC's estimate of potential supply as of December 31, 1982 and the cumulative production and proved reserves data as of December 31, 1981 must be made with difference in reporting dates in mind. Based upon Department of Energy data, cumulative production figures for 1982 are approximately 18 Tcf greater than those for 1981 presented here.

Estimates of ultimately recoverable volume, including the future potential estimated by the Potential Gas Committee plus past production and present proved reserves, have remained consistent considering the modifications to limiting parameters which have been made throughout the years. (See table 22.) The consistent total of ultimately recoverable volume reflects the fact that quantities of natural gas have been developed regularly from potential supply through exploration and drilling into proved reserves and ultimately into production. (Table 23 summarizes the ultimately recoverable volumes of natural gas in the United States by PGC reporting areas.)

Assuming that 1982 year-end proved reserves are equal to year-end 1981 (202 Tcf for total U.S. and 169 for the lower 48 states), the estimate of ultimately recoverable volume for the total United States is 1,711 Tcf and for the lower 48 states is 1,542 Tcf. Both of these estimates reflect the increase in proved reserves indicated in Department of Energy estimates for 1981, and are slightly higher than the estimates for year-end 1980. The estimate of potential supply reflects the net result of (1) transfers of volumes of natural gas from potential supply to proved reserves and production and (2) increases and decreases in estimates due to reevaluation of the potential based on newly available geological, geophysical and engineering data. The net decrease in estimates for the total U.S. is 37 Tcf. This quantity is slightly more than the amount estimated to have been added to proved reserves through new field

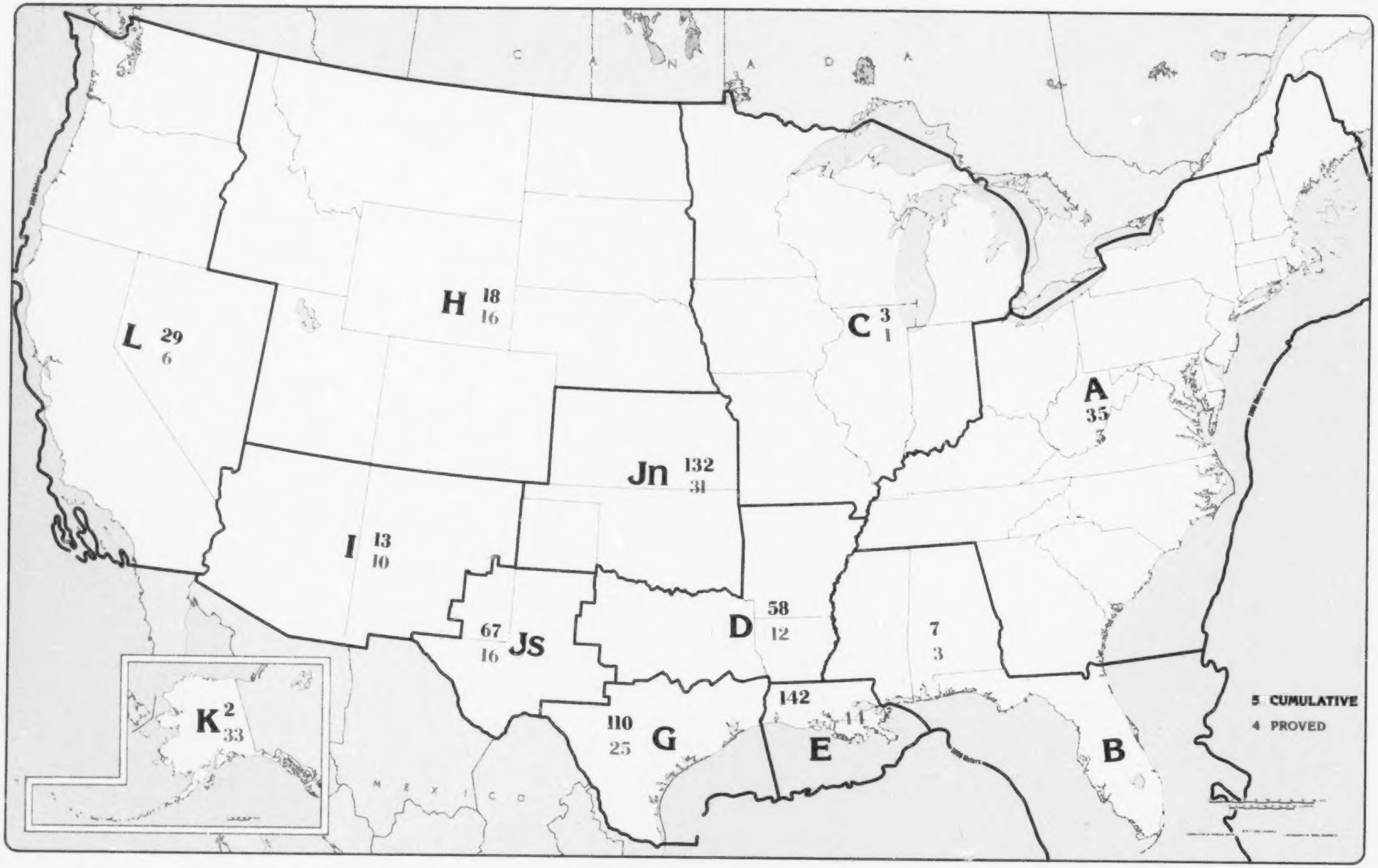

Figure 16 — Geographic distribution of cumulative natural gas production and proved natural gas reserves as of December 31, 1981

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and new pool discoveries and extensions over the past two years (1981 and 1982). When additions to proved reserves are accounted for, the net result of increases and decreases in estimates of potential resources is that there have been no substantial changes on a national basis. The estimates for individual areas have changed, however, and are summarized on a gross basis, combining all resource categories and depth intervals, in table 24.

The significant changes from 1980 to 1982 are:

Increases: Area H

Decreases: Areas G, J-North, K, and L.

Reasons for these changes are summarized in the repor of the Potential Gas Committee.

Table 22 — Comparison of estimates of ultimately recoverable volumes of natural gas in the United States for period December 31, 1966 to December 31, 1982 (trillions of cubic feet at 14.73 psia and 60° F.)

	(a)	(b)	(c)	(d)	(e)
	PREVIOUSLY DISCOVERED				ESTIMATE OF ULTIMATELY RECOVERABLE VOLUME (c + d)
	Cumulative Production(1)(2)	Proved Reserves(1)(2)	Production plus Reserves (a + b)	POTENTIAL SUPPLY (total of Probable. Possible and Speculative categories)	
Lower 48 States					
As of 12-31-66	307	286	593	690	1,283
As of 12-31-68	344	282	626	800	1,426
As of 12-31-70	387	260	647	851	1,498
As of 12-31-72	431	235	666	780	1,446
As of 12-31-76	514	184	698	698 to 748	1,396 to 1,446
As of 12-31-78	551	169	720	830	1,550
As of 12-31-80(2)	594	166	760	768	1,528
As of 12-31-82(2)	613*	169*	781*	742	1,523
Total United States**					
As of 12-31-68	345	287	632	1,227	1,859
As of 12-31-70	387	287	632	1,178	1,856
As of 12-31-72	432	266	698	1,146	1,844
As of 12-31-76	515	216	731	923 to 973	1,654 to 1,704
As of 12-31-78	553	200	753	1,019	1,772
As of 12-31-80(2)	596	199	795	913	1,708
As of 12-31-82(2)	615*	202*	817*	876	1,693

---

(1)Cumulative production and proved reserves estimates for 12-31-66 through 12-31-78 are estimates of the A.G.A. Committee on Natural Gas Reserves. Cumulative production figures reported for that period excluded gas in underground storage; the proved reserves figures included gas in underground storage.

(2)Cumulative production and proved reserves figures for 12-31-80 and 12-31-82 are estimated using data from the Office of Oil and Gas, DOE/EIA. Cumulative production figures include gas in underground storage; gas in underground storage is not included in proved reserves volumes.

*Cumulative production and proved reserves estimates are based on year-end 1981 data of the Office of Oil and Gas, DOE/EIA; 1982 data not available at the time of compilation. Cumulative production and proved reserves estimates do not add to table totals because of rounding.

**Alaska not estimated as of 12-31-66.

Table 23 — Summary of ultimately recoverable volumes of natural gas in the United States by geographic areas as of December 31, 1982*
(trillions of cubic feet at 14.73 psia and 60° F.)

	(a)	(b)	(c)	(d)			(e)
	PREVIOUSLY DISCOVERED — 1981			POTENTIAL SUPPLY — 1982			ESTIMATE OF ULTIMATELY RECOVERABLE VOLUME (c + d)
Area	Cumulative Production*	Proved Reserves*	Production plus Reserves (a + b)	Probable	Possible	Speculative	
A	35	5	40	27	8	49	124
B	7	3	10	7	8	35	60
C	3	1	4	—	2	1	7
D	58	12	70	8	20	19	117
E	142	44	186	27	51	—	264
G	110	25	135	23	31	4	193
H	18	16	34	49	93	66	242
I	13	10	23	2	3	1	29
J-North	132	31	163	24	60	39	286
J-South	67	16	83	15	33	1	132
L	29	6	35	2	17	17	71
Lower 48 States Subtotal	613**	169**	781**	184	326	232	1,523**
K-Alaska	2	33	35	8	29	97	169
Total United States	615**	202**	817**	192	355	329	1,693**

*Cumulative production and proved reserves estimates are year-end 1981 of the Office of Oil and Gas, DOE/EIA; 1982 data not available at the time of compilation.

**Area estimates do not add to national totals because of rounding.

Table 24 — Estimated potential supply of natural gas in the United States by geographic areas
(trillions of cubic feet at 14.73 psia and 60° F.)

Area	1976	1978	1980	1982
A	102	121(+19)	86(−35)	84(− 2)
B	51	53(+ 2)	54(+ 1)	50(− 4)
C	6	4(− 2)	3(− 1)	3
D	54	50(− 4)	51(+ 1)	47(− 4)
E	118	98(−20)	81(−17)	78(− 3)
G	93	85(− 8)	69(−16)	58(−11)
H	64	160(+96)	187(+27)	208(+21)
I	7	6(− 1)	6	6
J-North	107-157	143	135(− 8)	123(−12)
J-South	56	53(− 3)	51(− 2)	49(− 2)
K	225	189(−36)	145(−44)	134(−11)
L	40	57(+17)	45(−12)	36(− 9)
	923-973	1019(+60)	913(−105)	876(−37)

EXPLORATORY DRILLING, 1981 and 1982

In the years 1981 and 1982, exploratory drilling for gas and oil in the United States reached a record high level in terms of both the number of exploratory wells drilled and footage drilled.

Table 25 summarizes the number and footage of exploratory wells drilled for each of the years from 1972 through 1982. Estimates for the total number of exploratory wells drilled in the United States indicate that over 3,200 more exploratory wells were drilled in 1981 than were drilled in 1980 and approximately 1,300 more in 1982 than in 1981.

Exploratory drilling activity began to decrease sharply in the last half of 1982 in response to economic problems in the oil and gas industry and especially to decreased demand for natural gas. The level of activity in the first part of 1982 was sufficient, however, to result in a net increase in overall activity in 1982. All Potential Gas Committee areas except Areas B and K experienced an increase in both number of exploratory wells drilled and in total exploratory footage. Area B activity remained at about the same level of activity in 1982 as in 1980 while Area K experienced a decrease on the order of 50 percent. In several areas the average well depth decreased in spite of incentive pricing for gas below 15,000 feet. Total drilling activity, including both exploratory and development drilling, also increased markedly over the same time period (table 27).

Table 25 — Exploratory wells — total United States
(data from API Quarterly Review of Drilling Statistics)

	Number of Exploratory Wells Drilled	Footage	Average Well Depth
1972	7,539	45,043,798	5,975
1973	7,466	44,776,906	5,997
1974	8,619	50,261,744	5,832
1975	9,214	53,846,303	5,844
1976	9,234	52,812,406	5,719
1977	9,961	57,654,874	5,788
1978	10,677	63,234,745	5,923
1979	10,484	62,467,188	5,958
1980	11,916	69,948,320	5,870
1981	15,168	89,087,222	5,873
1982	16,470	95,587,432	5,804

Table 26 — Number of exploratory wells drilled, footage drilled, and average depth of wells — 1980 and 1982
(data from API Quarterly Review of Drilling Statistics)

	1980			1982		
Area	No. of Wells	Footage	Average Well Depth	No. of Wells	Footage	Average Well Depth
A	963	2,477,501	2,573	1,657	4,236,139	2,557
B	365	3,191,595	8,744	363	3,189,584	8,787
C	1,104	3,332,148	3,018	1,613	4,755,702	2,948
D	2,060	10,517,328	5,106	2,675	13,165,143	4,922
E	465	5,863,586	12,610	521	6,463,584	12,406
G	1,744	13,019,459	6,465	2,056	16,365,302	7,960
H	1,922	12,340,162	6,420	2,714	19,925,076	7,342
I	89	300,816	3,380	100	311,096	3,111
J-N	1,654	8,539,880	5,163	2,814	13,865,682	4,227
J-S	1,072	7,282,727	6,794	1,413	9,856,910	6,976
K	18	190,543	10,586	8	96,437	12,055
L	444	2,723,247	6,133	536	3,356,773	6,263
Total U.S.*	11,916	69,948,320	5,870	16,470	95,587,428	5,804

* Includes Gulf of Mexico-Northern

Table 27 — Drilling activity summary — 1973-1982
(data from API Quarterly Review of Drilling Statistics)

	Exploratory Wells		Total Wells	
	Number	Million Feet	Number	Million Feet
1973	7,466	44.8	26,592	136.4
1974	8,619	50.3	31,698	150.6
	15% increase over 1973		19% increase over 1973	
1975	9,214	53.8	37,235	174.4
	7% increase over 1974		17% increase over 1974	
	23% increase over 1973		40% increase over 1973	
1976	9,234	52.8	39,765	181.8
	1% increase over 1975		7% increase over 1975	
	24% increase over 1973		50% increase over 1973	
1977	9,961	57.7	46,479	215.0
	8% increase over 1976		17% increase over 1976	
	33% increase over 1973		75% increase over 1973	
1978	10,677	63.2	48,513	231.4
	7% increase over 1977		4% increase over 1977	
	43% increase over 1973		82% increase over 1973	
1979	10,484	62.5	51,263	243.2
	2% decrease over 1978		6% increase over 1978	
	40% increase over 1973		93% increase over 1973	
1980	11,916	69.9	62,462	288.9
	14% increase over 1979		22% increase over 1979	
	60% increase over 1973		135% increase over 1973	
1981	15,168	89.1	80,537	366.2
	27% increase over 1980		29% increase over 1980	
	103% increase over 1973		203% increase over 1973	
1982	16,470	95.6	88,106	401.4
	9% increase over 1981		9% increase over 1981	
	121% increase over 1973		231% increase over 1973	

PART III

POLICY GUIDELINES AND MEMBERSHIP OF THE POTENTIAL GAS AGENCY AND THE POTENTIAL GAS COMMITTEE

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POLICY GUIDELINES AND MEMBERSHIP OF THE POTENTIAL GAS AGENCY AND THE POTENTIAL GAS COMMITTEE

General Policy Statement

An appraisal of the long-range prospects of the natural gas industry in the United States — an appraisal that is useful for financial, managerial, and government purposes —requires, as an essential element, scientific, authoritative, and objective estimation of the potential supply of natural gas which may become available to the nation in addition to currently available proved recoverable reserves of natural gas.

The Potential Gas Committee fulfills this requirement by providing periodic estimates of the potential supply of natural gas which may become available. This Committee, together with its several Area Work Committees, is composed of about one hundred seventy individuals from the production, transmission, and distribution segments of the natural gas industry who are knowledgeable with respect to the potential supply of natural gas.

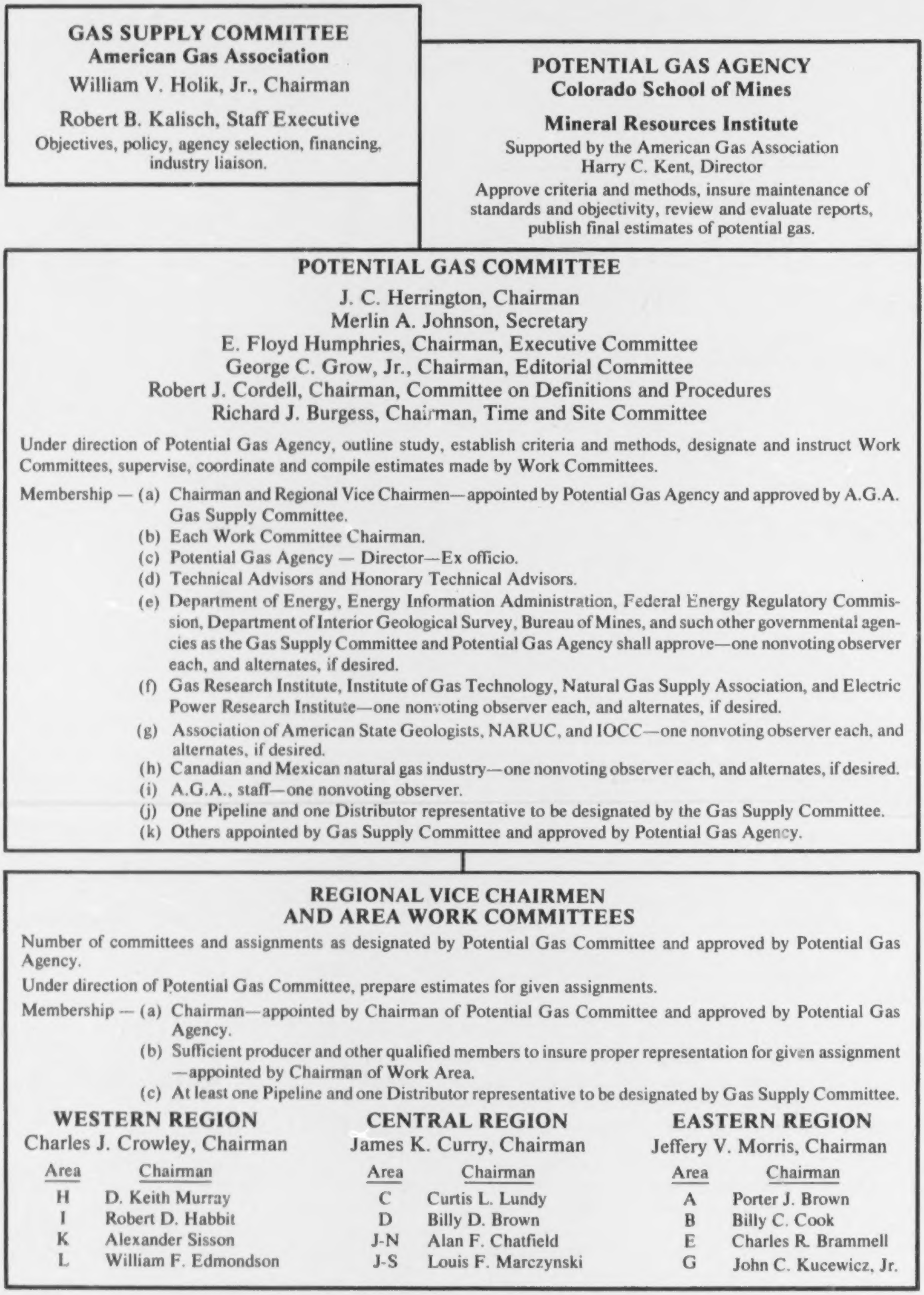
The quantities of natural gas included in this report by the Potential Gas Committee are only those which are considered to be recoverable by technology currently available or feasible in the foreseeable future. There are additional, potentially recoverable, quantities of natural gas contained in such situations as gaseous coal seams, geopressured zones, certain black shales, sandstones with very low permeability, and gas hydrates. Some workers have postulated large quantities of recoverable natural gas from each of these non-conventional sources, but there still remains considerable question as to the reasonable order of magnitude and the recoverability of this gas. These non-conventional sources largely have not been considered at this time by the Potential Gas Committee because the Committee feels that the technology of recovery has not yet been adequately demonstrated. As technological developments occur, the Committee will further study the potential from these sources and reconsider its estimates.

The Potential Gas Committee and its Area Work Committees discuss matters and data that are confidential. Fulfillment of the objectives of the Potential Gas Committee cannot be realized without the availability and utilizaton of information of a highly confidential nature. It is, therefore, the policy of the Potential Gas Committee and its Work Committees that every member, observer, and representative will respect such information and that there will be no disclosure of information or estimates, discussions, or other data, except as approved for release by the Potential Gas Committee.

A diagram of the organizational structure for the estimation of the potential supply of natural gas is shown in figure 17. A detailed description of the membership and duties of the several committees and of the Potential Gas Agency is presented in the sections which follow.

Membership of Committees and Policy Guidelines for Committees

The structure of the study of the potential supply of natural gas is divided into three parts consisting of the Gas Supply Committee of the American Gas Association, the Potential Gas Agency, and the Potential Gas Committee. The organization is shown graphically in figure 17.



GAS SUPPLY COMMITTEE
American Gas Association
William V. Holik, Jr., Chairman

Robert B. Kalisch, Staff Executive
Objectives, policy, agency selection, financing, industry liaison.

POTENTIAL GAS AGENCY
Colorado School of Mines

Mineral Resources Institute
Supported by the American Gas Association
Harry C. Kent, Director
Approve criteria and methods, insure maintenance of standards and objectivity, review and evaluate reports, publish final estimates of potential gas.

POTENTIAL GAS COMMITTEE
J. C. Herrington, Chairman
Merlin A. Johnson, Secretary
E. Floyd Humphries, Chairman, Executive Committee
George C. Grow, Jr., Chairman, Editorial Committee
Robert J. Cordell, Chairman, Committee on Definitions and Procedures
Richard J. Burgess, Chairman, Time and Site Committee

Under direction of Potential Gas Agency, outline study, establish criteria and methods, designate and instruct Work Committees, supervise, coordinate and compile estimates made by Work Committees.

Membership —
- (a) Chairman and Regional Vice Chairmen—appointed by Potential Gas Agency and approved by A.G.A. Gas Supply Committee.
- (b) Each Work Committee Chairman.
- (c) Potential Gas Agency — Director—Ex officio.
- (d) Technical Advisors and Honorary Technical Advisors.
- (e) Department of Energy, Energy Information Administration, Federal Energy Regulatory Commission, Department of Interior Geological Survey, Bureau of Mines, and such other governmental agencies as the Gas Supply Committee and Potential Gas Agency shall approve—one nonvoting observer each, and alternates, if desired.
- (f) Gas Research Institute, Institute of Gas Technology, Natural Gas Supply Association, and Electric Power Research Institute—one nonvoting observer each, and alternates, if desired.
- (g) Association of American State Geologists, NARUC, and IOCC—one nonvoting observer each, and alternates, if desired.
- (h) Canadian and Mexican natural gas industry—one nonvoting observer each, and alternates, if desired.
- (i) A.G.A., staff—one nonvoting observer.
- (j) One Pipeline and one Distributor representative to be designated by the Gas Supply Committee.
- (k) Others appointed by Gas Supply Committee and approved by Potential Gas Agency.

REGIONAL VICE CHAIRMEN
AND AREA WORK COMMITTEES

Number of committees and assignments as designated by Potential Gas Committee and approved by Potential Gas Agency.

Under direction of Potential Gas Committee, prepare estimates for given assignments.

Membership —
- (a) Chairman—appointed by Chairman of Potential Gas Committee and approved by Potential Gas Agency.
- (b) Sufficient producer and other qualified members to insure proper representation for given assignment —appointed by Chairman of Work Area.
- (c) At least one Pipeline and one Distributor representative to be designated by Gas Supply Committee.

WESTERN REGION
Charles J. Crowley, Chairman

Area	Chairman
H	D. Keith Murray
I	Robert D. Habbit
K	Alexander Sisson
L	William F. Edmondson

CENTRAL REGION
James K. Curry, Chairman

Area	Chairman
C	Curtis L. Lundy
D	Billy D. Brown
J-N	Alan F. Chatfield
J-S	Louis F. Marczynski

EASTERN REGION
Jeffery V. Morris, Chairman

Area	Chairman
A	Porter J. Brown
B	Billy C. Cook
E	Charles R. Brammell
G	John C. Kucewicz, Jr.

Figure 17 — Organization of Potential Gas Supply Studies

GAS SUPPLY COMMITTEE OF THE AMERICAN GAS ASSOCIATION

The membership of the Gas Supply Committee consists of representatives of member companies of the American Gas Association selected by the Chairman of the Board and approved by the Board of Directors of the American Gas Association.

The scope of the Committee is to coordinate, motivate, and make recommendations to the Board of American Gas Association as to the areas in which A.G.A. should become more active in the development of adequate gas supply for both short-term and long-term. In addition, the Committee undertakes special projects, where necessary, to evaluate industry gas supply programs. The Gas Supply Committee oversees the work of the Potential Gas Agency

The primary duties and responsibilities of the Gas Supply Committee with relation to potential gas studies include the following:

a. Establishing policy and objectives.
b. Providing required financial support.
c. Maintaining liaison with industry and industry organizations.
d. Selecting the Potential Gas Agency.
e. Approving the appointment of the Chairman and Regional Vice Chairmen of the Potential Gas Committee by the Potential Gas Agency.
f. Appointing pipeline and distributor representatives to the Potential Gas Committee as may be necessary or advisable.
g. Appointing such other members and observers to the Potential Gas Committee as may be necessary or advisable.
h. Assisting in procurement of qualified manpower to staff properly the Potential Gas Committee and the Area Work Committees.

The Gas Supply Committee of the American Gas Association takes no part in the work or the deliberations of the Potential Gas Committee or its sub-committees. The Gas Supply Committee does not participate in the studies leading to the estimates of potential supply of natural gas, and it neither approves nor disapproves the definitions and procedures, the estimates, or the report.

POTENTIAL GAS AGENCY OF THE COLORADO SCHOOL OF MINES

The Potential Gas Agency functions under the direction of the Vice President for Academic Affairs of the Colorado School of Mines. The School, with the approval of the Gas Supply Committee, appoints staff personnel to the Potential Gas Agency.

The Potential Gas Agency is supported by the American Gas Association. The American Gas Association is free, however, to take independent views of the operations and the studies produced by the Agency and its committees. The Agency is charged with the maintenance of scientific standards and objectivity of studies, and publishes the reports of the Potential Gas Committee. The Agency appoints the Chairman and Regional Vice Chairmen of the Potential Gas Committee, approves the appointment of members, representatives and observers to the Potential Gas Committee, and the chairmen of all sub-committees.

The Potential Gas Agency includes the following:

a. A Director, appointed by and responsible to the Colorado School of Mines.
b. Such additional staff personnel as may be required.
c. Members of the faculty of the Colorado School of Mines or other qualified individuals who may, from time to time, provide such professional services as the Director of the Potential Gas Agency and the Chairman of the Potential Gas Committee may determine necessary or desirable for discharging the duties of the Potential Gas Agency and the Potential Gas Committee.

The primary duties and responsibilities of the Potential Gas Agency include the following:

a. Approving criteria and methods established by Potential Gas Committee, including protecting the confidentiality of Potential Gas Committee data.
b. Insuring maintenance of the highest scientific standards and objectivity in Potential Gas Committee studies and reports.
c. Reviewing and evaluating reports prepared by the Potential Gas Committee.
d. Publishing, distributing, and publicizing reports of final estimates and other pertinent reports prepared by the Potential Gas Committee so as to assure the widest possible distribution and to promote understanding of them.
e. Further develop mutual understanding among the segments of the gas industry by helping the Gas Supply Committee unite the industry behind the potential gas studies.

f. Help improve industry-government relations in the public interest looking toward maximum acceptance and usefulness of potential gas studies.
g. Fulfill the professional obligation to publish technical papers concerning new techniques and knowledge gained.
h. Appointing Chairman and Vice Chairmen of Potential Gas Committee, with approval of Gas Supply Committee.
i. Approving appointment by Gas Supply Committee of other members, representatives and observers to the Potential Gas Committee.
j. Approving appointment of Chairman of Potential Gas Committee of Chairman of each Work Committee and chairmen of other committees.
k. Conduct the work of the Potential Gas Agency, in the public interest, in a manner which will enhance the stature of the Colorado School of Mines.
l. Adhere to the highest standards of objectivity.

The Colorado School of Mines may pursue other research, and individuals from the Agency may be involved in other research, consulting, and preparation and publication of papers in their professional fields, so long as these activities do not involve a conflict of interest nor invalidate the objectivity of the Agency.

POTENTIAL GAS COMMITTEE

The Potential Gas Committee comprises members, representatives, and observers from the producing, pipeline and distribution branches of the gas industry, together with observers from the American Gas Association, the Department of Energy, the Federal Energy Regulatory Commission, the U.S. Geological Survey, the National Association of Regulatory Utility Commissioners, the Interstate Oil Compact Commission, the Bureau of Mines, the Gas Research Institute, Institute of Gas Technology, Association of American State Geologists, Electric Power Research Institute, Natural Gas Supply Association and representatives from Canada.

The Chairman of the Potential Gas Committee is assisted by the three Regional Vice Chairmen and by an Executive Committee composed of senior members of the Potential Gas Committee, including past chairmen. It is the function of the Executive Committee to advise the Chairman on policy matters. An Editorial Committee is charged with approving the content of the report of the Potential Gas Committee.

The Definitions and Procedures Committee has the responsibility of reviewing and recommending to the membership of the Potential Gas Committee any proposed changes in the definitions and procedures used in the estimation of potential gas resources.

Membership of the Potential Gas Committee specifically includes the following:

a. Chairman of Potential Gas Committee.
b. Secretary of Potential Gas Committee.
c. Regional Vice Chairmen.
d. Chairman of each Area Work Committee.
e. Chairman of Executive Committee.
f. Chairman of Editorial Committee.
g. Chairman of Committee on Definitions and Procedures.
h. Chairman of Time and Site Committee.
i. Director of the Potential Gas Agency, ex officio.
j. Observer from the Federal Energy Regulatory Commission.
k. Observers from the Department of Energy.
l. Observer from the Geological Survey, United States Department of Interior.
m. Observer from the Bureau of Mines, United States Department of the Interior.
n. Observer from National Association of Regulatory Utility Commissioners.
o. Observer from the Interstate Oil Compact Commission.
p. Observer from Natural Gas Supply Association.
q. Observer from Association of American State Geologists.
r. Observer from the Gas Research Institute.
s. Observer from the Institute of Gas Technology.
t. Observer from Electric Power Research Institute.
u. Representative from the natural-gas pipeline industry.
v. Representative from the natural-gas distribution industry.
w. Observer representing the American Gas Association.
x. Observer from the Canadian natural gas industry and observer from the Mexican natural gas industry.
y. Technical Advisors and Honorary Technical Advisors.
z. Representatives and observers from other organizations may be recommended for appointment by the Potential Gas Agency Director and approved by the Gas Supply Committee.

All members of the Potential Gas Committee, except those specifically designated as observers, are considered as voting members of the Potential Gas Committee. Observers are invited and encouraged to participate in discussion of items brought before the Potential Gas Committee but do not have a vote in the determination of policy and procedure. Alternates to representatives and observers may be appointed.

Candidates for Committee Chairmen and Vice Chairmen normally will be geologists or persons with geology background from the academic community, pipelines, independent firms, gas utilities or producing companies. Retired or semi-retired gas industry people are not excluded from consideration.

Officers of the Potential Gas Committee and Area Work Committees are appointed as outlined in the Organizational Chart (fig. 17). Normally they serve for a period of one report. They are eligible for reappointment, however, for one additional report period. In calculating eligibility for reappointment, a partial term of office shall not be counted. This policy shall not operate to disqualify a member from longer service by reason of elevation in the organization. In other words, the two-term limitation shall apply to each position held, considering each membership or officership on a work committee or top committee as a separate position.

All officers, regional chairmen, and the pipeline and distributor representatives appointed by the American Gas Association Gas Supply Committee shall be subject to the two-report limit. Exceptions must be recommended by the appropriate Committee Chairman and the Potential Gas Agency Director, and approved by the American Gas Association Gas Supply Committee.

Technical Advisors include persons who have special knowledge of the occurrence of natural gas or the natural gas industry and whose expert advice will contribute to the successful performance of the Committee's assignments. Past Chairmen of Work Areas and Past Regional Vice Chairmen of the Potential Gas Committee will be appointed as Technical Advisors if they are willing to continue to participate in the work of the Committee. The appointment of Technical Advisors is approved by the Gas Supply Committee upon recommendation by the Potential Gas Agency Director. Technical Advisors are appointed for the preparation of a specific PGC report. Their appointment may be continued indefinitely but is subject to review and approval at the time of organization of the Potential Gas Committee for each succeeding report.

The designation of Honorary Technical Advisor may be given to such persons as have performed exceptional service to the Potential Gas Committee and whose continued participation and advice are desirable for the continued successful operation of the Committee. Honorary Technical Advisors are permanent voting members; their appointment is recommended by the Executive Committee and approved by the Potential Gas Agency Director and the Gas Supply Committee.

Observers from sponsoring associations, governmental agencies, and other cooperating groups serve at the discretion of these organizations and are not subject to the two-report policy.

The primary duties and responsibilities of the Potential Gas Committee include the following:

a. Outlining the scope and coverage of the estimates of potential natural gas supply.
b. Establishing criteria and methods for estimation of potential natural gas supply and other pertinent studies.
c. Designating Work Areas and Special Projects.
d. Appointing the Chairman of each Area Work Committee (by action of Chairman of Potential Gas Committee).
e. Approving appointment of other members of each Area Work Committee who are appointed by the Chairman of each Area Work Committee (by action of Chairman of Potential Gas Committee).
f. Instructing Area Work Committees.
g. Supervising, coordinating, advising, reviewing, evaluating, approving, and compiling estimates and such other assignments as may be given to committees.
h. Preparing reports of final estimates and such other reports as may be pertinent.
i. Submitting reports of final estimates and other pertinent reports to the Potential Gas Agency and counseling with Director regarding publication and distribution of such report.

AREA WORK COMMITTEES

Twelve Area Work Committees are the backbone of the Potential Gas Committee. Each of the Work Committees has the responsibility of developing an estimate of the potential supply of natural gas in a particular part of the United States. Following the system long used by the petroleum industry, each Area Work Committee is assigned geologically significant areas (without specific regard to state lines) in which the Committee members have expert working knowledge. These Committee members with their fund of information (often confidential), are the source of knowledge and judgment for estimating the undiscovered gas supply in each area. Because geologic rather than geographic divisions are used, publication of estimates by individual states is not feasible.

The membership of Area Work Committees consists of employees and consultants associated with the producing, pipeline, and distribution segments of the gas industry — as well as qualified personnel from State and Federal Agencies and educational institutions.

For administrative purposes, the Area Work Committees are grouped together in three regions: Eastern, Central and Western. Each of these regions is supervised by a Regional Vice Chairman who coordinates activities of the Area Work Committees within his jurisdiction and works with the Potential Gas Comittee Chairman in order to assure that there is an open flow of communication in both directions, and that the established techniques for resource estimation are being followed by the Area Work Committees.

Membership of Area Work Committees includes the following:

a. Chairman of each Area Work Committee.
b. An appropriate number of qualified working members deemed necessary by the Chairman of each Work Committee to insure the most objective estimates of potential supply of natural gas in the respective area assigned. Work Committee members are individuals from the natural gas and oil industries and other individuals who are qualified by their knowledge and experience to make estimates of potential supply of natural gas. The individuals are selected for each area because they have a close, working knowledge in all aspects of natural gas exploration and production.
c. At least one qualified representative on each Area Work Committee from the natural gas pipeline industry, appointed by the Gas Supply Committee.
d. At least one qualified representative on each Area Work Committee from the natural gas distribution industry, appointed by the Gas Supply Committee. (This requirement is waived for the Area K, Alaska, Committee.)

The Chairman and Vice Chairman of each Area Work Committee are subject to the two-report limit. Exceptions must be recommended by the Regional Vice Chairman, approved by the Potential Gas Committee Chairman and the Potential Gas Agency Director, and reported to the Gas Supply Committee, and only after receiving a clearance letter from the member's employer.

Other members of the Area Work Committees, appointed by the Area Chairman, will normally participate in the preparation of two successive reports. Service beyond the preparation of two reports may be continued if necessary to maintain adequate expertise and continuity on the Area Work Committee. Continuation of service beyond two reports must be recommended by the Area Chairman and approved by the Regional Vice Chairman, the Potential Gas Committee Chairman, and the Potential Gas Agency Director.

The primary duties and responsibilities of Area Work Committees include the following:

a. Appointing appropriate number of qualified working members to insure proper representation of various sectors of the industry and objectivity for the best estimates of potential supply of natural gas for the assigned areas (by action of Chairman of each Area Work Committee).
b. Estimating quantity of potential supply of natural gas in working areas designated by the Potential Gas Committee pursuant to the guidelines and parameters established by the Potential Gas Committee and approved by the Potential Gas Agency, and such other studies as may be assigned by the Potential Gas Committee.
c. Performing such other assignments as may be made in the respective area assigned by the Potential Gas Committee regarding such estimate.

Each member of each Area Work Committee will submit his estimates of potential supply of natural gas and such other assignments as may be given to him in his assigned sub-area to the Chairman and other members of his committee for review, evaluation, and approval.

Since the type and quantity of available information upon which to base estimates of potential natural gas supply vary widely from area to area, the Area Work Committee members use varied approaches in making their estimates. Inasmuch as the individual members work with private information obtained on a confidential basis from many sources, their working papers are not revealed in detail to anyone, including other members of the same Area Work Committee or others in the Potential Gas Committee. Without such confidential information, the Potential Gas Committee could not perform its task; therefore, each member, observer, or representative of the Work Committees is aware of and must respect the confidential nature of the data made available to him and of the estimates and other assignments prepared or reviewed by the Area Work Committees and the Potential Gas Committee.

Standing Committees of the Potential Gas Committee

EXECUTIVE COMMITTEE

The Executive Committee shall serve as the administrative coordinating committee for the Potential Gas Committee. It shall consider and discuss any matters of policy which are brought to its attention and shall make recommendations to the Potential Gas Committee regarding changes in policy. It shall act on behalf of the Potential Gas Committee on matters of urgency which arise between regularly scheduled meetings of the Potential Gas Committee. It may also be empowered to act on behalf of the Potential Gas Committee on matters designated by the Potential Gas Committee. At such times as vacancies occur in the following offices, the Executive Committee shall either act as a nominating committee to recommend suitable candidates or appoint a nominating committee from among its membership: PGC Chairman, Regional Vice Chairmen, Secretary of the PGC, and Chairman of the Executive Committee.

Chairmen of PGC standing committees, with the exception of the Executive Committee, will be appointed by the PGC Chairman, subject to approval by the Executive Committee. All actions of the Executive Committee will be reported to the membership of the Potential Gas Committee at their next regularly scheduled meeting, and shall be subject to review and approval by the Potential Gas Committee.

Membership

Chairman, elected from the membership of the Potential Gas Committee by the voting members of the PGC at a regular meeting. Nominations for Chairman will be made by the Executive Committee and nominations will also be received from the floor. Normally, the Chairman will be elected at the fall meeting following publication of the biennial PGC report and will serve for two years. Vacancies will be filled by election at the next regular PGC meeting, following the same procedure and a Chairman so elected will serve for the remainder of the unexpired term. In the absence of the elected Chairman, the Chairman of the Potential Gas Committee will serve as Chairman of the Executive Committee.

The following ex officio voting members: PGC Chairman, PGC Regional Vice Chairmen, Secretary of the PGC, Potential Gas Agency Director, Chairmen of Standing Committees, representatives appointed to the PGC from the natural-gas pipeline and natural-gas distribution industries, representative from the Canadian gas industry, observer from the American Gas Association.

In addition, a maximum of 5 voting Technical Advisors may be appointed by the Potential Gas Committee Chairman, subject to approval by the Potential Gas Agency Director.

EDITORIAL COMMITTEE

The Editorial Committee will review and approve the editorial content and format of PGC reports. They will work closely with the Potential Gas Agency in the publication of all official publications of the Potential Gas Committee.

Membership

Chairman, appointed by the Potential Gas Committee Chairman, and approved by the Executive Committee. Four members of the Potential Gas Committee, appointed by the Editorial Committee Chairman, with approval of the PGC Chairman. PGC Chairman, ex officio; Potential Gas Agency Director, ex officio.

COMMITTEE ON DEFINITIONS AND PROCEDURES

This Committee has the responsibility of reviewing and recommending to the membership of the Potential Gas Committee any proposed changes in the definitions and procedures used in the estimation of potential gas resources. Proposals to be reviewed by this Committee may be submitted by any member of the Potential Gas Committee. The Committee will further review estimates of potential gas resources made by other organizations which come to the attention of the Committee and may, from time to time, as deemed appropriate, prepare publications dealing with the comparison of the work of the Potential Gas Committee with that of other organizations. The Committee on Definitions and Procedures will also serve as liaison with the U.S. Geological Survey Resource Appraisal Group and other such organizations as are involved in the work of estimation of potential gas resources.

Membership

Chairman, appointed by the PGC Chairman, and approved by the Executive Committee. Four members of the Potential Gas Committee, appointed by the Chairman of the Committee on Definitions and Procedures, with approval of the PGC Chairman. PGC Chairman, ex officio; PGA Director, ex officio.

TIME AND SITE COMMITTEE

This Committee will select an appropriate location and date for each national PGC meeting which will serve best the needs of the Committee. Once the site and date of each meeting have been selected by the Committee, the Potential Gas Agency will be charged with the responsibility of completing the arrangements for the meeting. The Time and Site Committee will also coordinate any regional meetings which are scheduled by Regional Vice Chairmen in order that the dates of such meetings shall not be in conflict.

Membership

Chairman, appointed by the PGC Chairman, and approved by the Executive Committee. Two members of the Potential Gas Committee, appointed by the Chairman of the Time and Site Committee, and approved by the PGC Chairman. Regional Vice Chairmen, ex officio; PGC Chairman, ex officio; PGA Director, ex officio.

Communications

COMMUNICATION BETWEEN COMMITTEES

The formal channel of communication shall be from the Area Work Committees to the Potential Gas Committee to the Potential Gas Agency to the American Gas Association Gas Supply Committee and vice versa.

PUBLIC COMMUNICATION

Members of the Potential Gas Agency, the Potential Gas Committee, and the Area Work Committees are encouraged to publicize and explain their work. These efforts should be limited to explaining the methodology used, comparative methodology, and the strengths and limitations of the work. When acting as spokesmen for the Committee, members shall refrain from interpreting study results in terms of national policy needs or required industry incentives. Members who are called upon to make talks and write papers on behalf of the Committee should submit texts to the Potential Gas Agency for comment and policy review.

MEMBERSHIP OF THE POTENTIAL GAS AGENCY AND POTENTIAL GAS COMMITTEE

POTENTIAL GAS AGENCY

Harry C. Kent, Director
Lee C. Gerhard, Associate Director
Ladine Rintoul, Administrative Assistant

POTENTIAL GAS COMMITTEE

J. C. Herrington, Chairman
Charles J. Crowley, Vice Chairman, Western Region
James K. Curry, Vice Chairman, Central Region
Jeffery V. Morris, Vice Chairman, Eastern Region
Merlin A. Johnson, Secretary

Executive Committee

E. Floyd Humphries, Chairman

Charles M. Allen
A. M. Derrick
Richard J. Murdy
E. A. Rassinier
ex officio:
Donald W. Axford

Richard J. Burgess
Robert J. Cordell
Charles J. Crowley
James K. Curry
George C. Grow, Jr.
J. C. Herrington
Merlin A. Johnson
Robert B. Kalisch

Harry C. Kent
Monty G. Martin (alt.)
Charles P. Moreton
Jeffery V. Morris
Charles L. Neumeyer
A. A. Wilkins (alt.)

Editorial Committee

George C. Grow, Jr., Chairman

Charles J. Crowley
A. M. Derrick
William E. Mantek
Charles L. Neumeyer
David A. Rochester

ex officio:
J. C. Herrington
Harry C. Kent

Committee on Definitions and Procedures

Robert J. Cordell, Chairman

Richard J. Burgess
Charles J. Crowley
Lucio A. D'Andrea
Donald E. Hallinger
David A. Rochester

John C. Sharer
C. W. Spencer
ex officio:
J. C. Herrington
Harry C. Kent

Time and Site Committee

Richard J. Burgess, Chairman

Charles J. Crowley
James K. Curry
Jeffery V. Morris

ex officio:
J. C. Herrington
Harry C. Kent

Area Work Committees

Area	*Chairman*	*Vice Chairman*
A	Porter J. Brown	Paul G. Freund
B	Billy C. Cook	John M. Richart
C	Curtis L. Lundy	John Avila
D	Billy D. Brown	—
E	Charles R. Brammell	John H. McElroy
G	John C. Kucewicz, Jr.	Bill C. Burkman
H	D. Keith Murray	C. Keith Fisher
I	Robert D. Habbit	Edward M. Allshouse
J-N	Alan F. Chatfield	Joe E. McGarrah
J-S	Louis F. Marczynski	C. K. McLaughlin
K	Alexander Sisson	—
L	William F. Edmondson	Kenneth E. Wainwright

Observers

Donald W. Axford, D. W. Axford & Associates Ltd. (Canada)
Ellis R. Boyd, Jr., Division of Reserves & Natural Gas (DOE/EIA)
Lucio A. D'Andrea, Division of Reserves & Natural Gas (DOE/EIA)
Gordon L. Dolton, U.S. Geological Survey
W. Timothy Dowd, Interstate Oil Compact Commission
Charles G. Groat, Association of American State Geologists
E. Bruce Hagen, National Assn. of Regulatory Utility Commissioners
Tommie C. Hillis, Federal Energy Regulatory Commission (alternate)
Robert B. Kalisch, American Gas Association
Gordon W. Koelling, Division of Reserves & Natural Gas (DOE/EIA)
Jeremy Platt, Electric Power Research Institute
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J. Glenn Seay, Institute of Gas Technology
John C. Sharer, Gas Research Institute
Wayne M. Thompson, Federal Energy Regulatory Commission
David O. Webb, Gas Research Institute (alternate)
A. A. Wilkins, TCPL Resources, Ltd. (Canada, alternate)
Victor Wulc, Natural Gas Supply Association

Representatives

Monty G. Martin — Pipelines (alternate)
Charles P. Moreton — Pipelines
Charles L. Neumeyer — Gas Distributors
Willis B. Wood, Jr. — Gas Distributors (designate)

Technical Advisors

Francis J. Barker
James A. Barlow, Jr.
E. Perry Bendler
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Richard J. Burgess
Robert J. Cordell
A. M. Derrick
Robert W. Gallagher
Dan B. Grubb
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John D. Haun
E. Floyd Humphries
William E. Mantek
Paul Mounce
Michael J. Popovich
Charles E. Smith
Gordon K. Zareski

Honorary Technical Advisors

Charles M. Allen
B. Warren Beebe
Mark V. Burlingame (deceased)
George C. Grow, Jr.
John M. Hanley
Richard J. Murdy
E. A. Rassinier
Lyon F. Terry (deceased)

ALLEN, C. M. (9)+: Oil & Gas Consultant, Homasassa Springs, FL 1981-. Phillips Petrol. Co., Bartlesville, OK, employed in various capacities in the Exploration and Production Dept. 1944-81. Adv. Board to Dept. of Geol., Univ. KS 1973-76. Mem. Am. Assn. Petrol. Geol. (Comm. on Emergency Preparedness 1974-76, Comm. on U.S. Energy Outlook 1970-73), Fed. Power Comm. Natl. Gas Surv. (Gas Supply Task Force 1971-75). Has testified in numerous state conservation agency, state and federal courts, and Fed. Power Comm. proceedings (including all major area and national rate proceedings), and hearings before Senate and House Congressional Committees. (Honorary Technical Advisor.)

AXFORD, Donald W. (7): Pres., D.W. Axford & Associates, Consulting, Calgary, Canada 1978-. Director: Frio Oils Ltd., Strand Oil & Gas Ltd.; Rock Ore Mining, DB&K Oils Ltd., Pres. 1977-78. Petro-Canada Inc., Sr. V. Pres., Expl. & Dir.; Pan Arctic Oils Ltd., Dir. 1976-77. Mobil Oil Canada, V. Pres., Expl. & Dir. (Calgary) 1948-76. Mem. Am. Assn. Petrol. Geol. (Adv. Council, Energy Minerals Div. Tar Sands Councilor), Canadian Petrol. Geol., Geol. Assn. Canada, Prof. Engr. Alberta, Soc. Econ. Paleon. & Min. (CANADA — Chairman.)

BARKER, Francis J. (5): V. Pres., Nat. Gas & Gas Liquids Dept., Oil & Gas Div., Union Oil Co. of CA, Los Angeles, CA 1971-; Gen. Mgr. (Chicago) 1970-71; Mgr. Opr. (Midland) 1967-70; Mgr. Engr. (Thums-Long Beach Co.) 1965-67; Dist. Mgr. (Santa Maria) 1963-65; Mgr. Expl. (Canary Islands, Spain) 1960-63; Supt. (Coalinga) 1957-60; Engr. 1948. Mem. Am. Petrol. Inst., Am. Inst. Min. Engr., Am. Assn. Petrol. Geol., Gas Processors Assn. (Board of Dir.), Am. Gas Assn. (Steering Comm., Gas Supply).

BARLOW, James A. Jr. (4): V. Pres., Barlow & Haun, Inc., Casper, WY 1957-. Forest Oil Corp., Geol. 1953-57. Ohio Oil Co., Geol. 1952-53. Mem. Am. Assn. Petrol. Geol., Assn. Prof. Geol. Scientists, Geol. Soc. Am., Rocky Mtn. Assn. Geol., WY Geol. Assn., Independent Petrol. Assn. Mtn. States.

BEEBE, B.W. (9): Geol., Geophysicist & Energy Consultant, Tulsa, OK 1980-. Geol., Geophysicist & Energy Consultant (Boulder, CO) 1972-80. Millison & Beebe (Partner) 1969-72. M. M. & B., Inc., V. Pres. & Sec., 1964-72, Ind. Geol. and Geophysicist 1959-64. Keating Drlg. Co., V. Pres. and Dir. 1955-58. Manhart, Millison & Beebe (Partner) 1950-55. Anderson-Prichard Oil Corp., Expl. Mgr. 1947-50. Bay Petrol. Corp., Ch. Geol., Expl. Mgr. (organized expl. dept.); V. Pres. 1942-47. Lerke & Whortan, Assoc. Cons., 1939-41. British-American Oil Prod. Co., Div. Geol. 1938-39. Shell Petrol. Corp., Geol. and Asst. to V. Pres. Expl., 1935-38. KS Emergency Relief Comm., Geol. 1934, Mem. Am. Assn. Adv. Science (Fellow), Geol. Soc. Am. (Fellow), Am. Assn. Petrol. Geol. (Hon. mem., Mem. 9: Natural Gases of N.A. [ed.] 1968, Dist. Lecturer 1969-70), OK Geol. Soc. (Hon. mem.), Rocky Mtn. Assn. Geol. (Hon. mem.), Am. Arbitration Assn., Am. Gas Assn., Assn. Prof. Geol. Scientists, KS Geol. Soc., Oklahoma City Geol. Soc., Soc. Expl. Geophysicists, Soc. Ind. Prof. Earth Scientists, Soc. Petrol. Engr., Rocky Mtn. Nat. Gas Men's Assn. (Honorary Technical Advisor.)

BENDLER, E. Perry (9): Geol., Expl. & Dev., The East Ohio Gas Co., Cleveland, OH 1955-. Mem. Am. Assn. Petrol. Geol. (Comm. on Statistics of Drlg.), Assn. Prof. Geol. Scientists (Cert. #2473), No. OH Geol. Soc., OH Geol. Soc., OH O&G Assn.

BENNETT, William E. (9): Pres., Phoenix Hydrocarbon, Ltd., Charleston, WV 1979-; GASAMEX, Ltd., Pres. (Charleston, WV) 1977 and V. Pres.-Expl., Monitor Petrol. Corp., (NYC, Charleston, WV) 1976-; Geol./Geophysicist 1974-76. Monitor Resources Corp., NYC, Cons. 1976-. Lunsford Granite Materials, Elberton, GA, V. Pres. 1976-. United Fuel Gas Co., Sr. Geophysicist 1969-74, Geophysicist 1962-68. Geol. 1957-61. Mem. Am. Assn. Petrol. Geol., Assn. Prof. Geol. Scientists (Cert. #1642, Past Pres. WV Sec.), Soc. Expl. Geophysics, Ind. O&G Assn. WV, OH Geol. Soc., Appalachian Geol. Soc., Fed. Power Comm. Natl Gas Surv. (Tech. Adv. 1975-76), Am. Gas Assn. (Atl. Action Comm. 1974-75).

BOYD, Ellis R. Jr. (1): Office of Oil & Gas, Div. of Reserves & Nat. Gas, DOE/EIA, Washington, D.C.; Chief, Reserves and Prod. Branch Deputy Dir., Office of Oil & Gas Information System 1977-. Federal Power Comm., held various positions in Area Rate Div. including Deputy Dir., Planning & Develop. Div.; Bureau of Nat. Gas and Chief, Planning & Spec. Proj. Branch. Marathon Oil Co., various production engineering and supervisory posts, Gulf Coast area 1954-66. Mem. Soc. Petrol. Engrs.

BURGESS, Richard J. (7): President, Northern MI Expl. Co., Jackson, MI 1981-; Exec. V. Pres. 1980-81; V. Pres. 1967-80. Consumers Power Co., Exec. Dir. Expl. 1967-80; Expl. Supv. 1963-67. Panhandle Eastern Pipe Line Co., Geol. 1962. Plymouth Oil Co., Geol. 1960-61. Imperial Oil Ltd. (Canada), Geol. 1954-60. Mem. Am. Assn. Petrol. Geol. (CPG #462), Geol. Soc. Am., MI O&G Assn., MI Basin Geol. Soc., Ontario Petrol. Inst.

BURLINGAME, Mark V. (9): Burlingame Consultants, Bradenton, FL 1967-. Nat. Gas Pipeline Co. of Am., Planning, Construction & Opr. Pipeline System, Offshore and Onshore Expl. Programs, Gas Storage in Aquifer fms. (dev.), Sr. V. Pres. Opr. (ret.) 1930-67. Served the Dept. of Interior as natural gas operations consultant and as the U.S. representative observer to the United Nation's European Economic Committee's Gas Energy Committee, served on technical natural gas missions behind the Iron Curtain. Mem. Am. Assn. Petrol. Geol. (Cert.), Am. Gas Assn., Am. Geol. Inst., Assn. Ind. Pet. Geol., Am. Pet. Inst., So. Gas Assn. (Honorary Technical Advisor.) (Deceased.)

CORDELL, Robert J. (4): President, Cordell Reports Inc., Richardson, TX 1980-; Consultant (Dallas, TX) 1977-80. Suntech Inc., Sr. Prof. Scientist, Energy Tech. and Sciences Dept., Res. and Engr. Div. (Richardson, TX) 1975-77. Sun Oil Co., Research Scientist, Sr. Research Scientist 1970-75;

+Number in parenthesis following name indicates number of Potential Gas Committee reports in which member participated.

Sr. Sec. Mgr., Geol. Research 1963-70; Mgr. Geol. Research 1955-63; Research Paleontologist-Research Geol.-Sr. Research Geol. 1951-55. Mem. Am. Assn. Adv. Sci. (Fellow), Am. Assn. Petrol. Geol., Dallas Geol. Soc. (Hon. Life Mem.), Dallas Geophys. Soc., Geol. Soc. Am. (Fellow), Paleon. Soc., Soc. Econ. Paleon. and Mineralogists.

CROWLEY, Charles J. (5): Consulting Reservoir Geol., El Paso Natural Gas Co., El Paso, TX 1977-; Sr. Reservoir Geol. 1965-77. Hercules Powder Co., Supr. 1962-65. Consultant (WY & AZ) 1958-62. Forest Oil Corp., Area Geol. 1953-59. Marathon Oil Co. (OH Oil), Scout-Area Geol. (Billings and Casper) 1949-53. Mem. Am. Assn. Petrol. Geol., El Paso Geol. Soc., Soc. Mining Engr., Reg. Geol. (AZ).

CURRY, James K. (9): Geological Consultant, Denver, CO 1981-. Panhandle Eastern Pipe Line Co., Mgr. Rocky Mtn. Region (Denver, CO) 1975-81; Mgr. Expl. & Prod. (Pan Eastern Expl., Houston) 1973-75; Mgr. Expl., Mgr. Geol., Dist. Geol., Geol., Jr. Geol. (Liberal, KS) 1946-72. Mem. Am. Assn. Petrol. Geol., Soc. Petrol. Engr., Rocky Mtn. Assn. Geol., Assn. Ind. Petrol. Geol.

D'ANDREA, Lucio A. (5): Div. of Reserves & Nat. Gas, Energy Information Admin., U.S. Dept. of Energy, Washington, D.C. Experience of about 20 years in various aspects and activities of natural gas industry - production, transportation, distribution and alternate gas supplies. Mem. Soc. Petrol. Engrs., Soc. Military Engr.

DERRICK, A. M. (9): Sr. V. Pres., Marketing, Rates, Regulatory Affairs, Customer Relations, Gas Transportation & Exchange, El Paso Natural Gas Co., El Paso, TX 1977-; V. Pres. 1972-77; Asst. V. Pres. 1966-72; Mgr. Res. Engr. 1959-66; Asst. Mgr. Res. Engr. (Houston, TX) 1958-59; Sr. Res. Engr. 1953-57. Stanolind Oil & Gas Co., Res. Engr. Supr. (Midland, TX) 1951-53; Jr. Petrol. Engr. (Wink, TX) 1950-51, (Tulsa, OK) 1949-50, (Pampa, TX) 1947-48. Mem. Am. Assn. Petrol. Geol., Am. Inst. Min., Met. & Petrol. Engr.-SPE, Soc. Petrol. Eval. Engr.

DOLTON, Gordon L. (4): Proj. Chief, Resource Assessment Group-Domestic, Br. Oil and Gas Resources, U.S. Geological Survey, Denver, CO 1975-; Geol., Resource Appraisal Group 1974-75. Shell Oil Co., Staff Geol. (Houston) 1973-74; Staff head, Planning and Venture Development (Denver) 1963-66; Sr. Geol. (Okla. City) 1963-66; Geol. (WY) 1954-60. Shell Development Co., Research Geol. (Houston) 1960-63. Richfield Oil Corp., Geol. 1951-52. Mem. Am. Assn. Petrol. Geol., Geol. Soc. Am., Rocky Mtn. Assn. Geol.

DOWD, W. Timothy (3): Exec. Dir., Interstate Oil Compact Commission, Oklahoma City, OK. Involvement in a variety of governmental activities as either an observer or participant including Oklahoma House of Representatives and counsel to the Governor of Oklahoma. Mem. Am. Bar Assn., OK Bar Assn., Fed. Energy Bar Assn.

GALLAGHER, Robert W. (6): Consultant, Houston, TX 1981-. Southern Natural Gas Co., Mgr., Reserves and Deliverability (Houston, TX) 1967-81: Sr. Engr. 1962-67. Mem Am. Assn. Petrol. Geol.

GERHARD, Lee C. (1): Prof. Geol., Colorado School of Mines, Golden, CO and Assoc. Dir., Potential Gas Agency and Consultant, Gerhard and Associates 1982-. Supron Energy Corp. (Englewood, CO), Expl. Mgr. 1981-82. ND Geol. Survey, State Geol. & Dir. 1977-81; Asst. State Geol. 1975-77. Univ. ND, Chmn. and Prof. Geol. 1977-81; Assoc. Prof. Geol. 1975-77. West Indies Lab. and Fairleigh Dickinson Univ., Act. Dir. and Assoc. Prof. Geol. 1975; Asst. Dir. and Assoc. Prof. 1972-75. Univ. So. CO, Assoc. Prof. Geol. 1966-72. Sinclair Oil & Gas Co., Reg. Stratigrapher, 1965-66; Expl. Geol. 1964-65. Amerada Petrol. Corp., Party Chief 1962. Univ. KS, Inst. Geol., Asst. Inst. Geol., Teaching Fellow 1960-64. Mem. Am. Assn. Petrol. Geol., Am. Inst. Prof. Geol., Assn. Am. State Geol., CO Scient. Soc., Geol. Soc. Am., ND Geol. Soc., Rocky Mtn. Assn. Geol., Soc. Econ. Paleon. & Min.

GROAT, Charles G. (1): Dir. & State Geol., Assn. Am. State Geol., Baton, Rouge, LA.

GROW, George C. Jr. (9): Consulting Geol., Westfield, NJ 1974-. Transcontinental Gas Pipe Line Corp., Ch. Geol.-Eastern area (NJ) 1950-73. The Peoples Natural Gas Co., Jr. Geol. to Ch. Geol. (PA) 1939-50. Standard Oil Co. (NJ), Geol. (Venezuela) 1938-39. Mem. Am. Assn. Petrol. Geol. (Cert. #31, Treas. 1974-76, Adv. Council 1976-, Fndn. Dev. Coord. 1973-), Am. Inst. Min., Met. & Petrol. Engr., Assn. Prof. Geol. Scientists (Cert. #1774), Geol. Soc. Am. (Fellow), Pittsburgh Geol. Soc. (Past Pres.), Am. Gas Assn. (Comm. Underground Storage 1951-73, Chmn. 1960-61; Task Group on Gas Storage Statistics, Chmn. 1964-71), Am. Petrol. Inst., PA Oil & Gas Assn., Ind. Oil & Gas Assn. WV, Lamont-Doherty Geol. Observatory, Columbia Univ. (Adv. Council), Fed. Power Comm. Natl. Gas Surv. (Underground Storage Task Force 1972-73; Prospective Expl. & Development Task Force 1975-). (Honorary Technical Advisor.)

GRUBB, Dan B. (1): V. Pres., Gas Supply, Natural Gas Pipeline Co., Houston, TX 1979-; Asst. V. Pres. for Gas Expl. and Prod., Asst. Chief Engineer and other key engineering and operational posts 1962-79. Mem. Am. Gas Assn., Interstate Nat. Gas Assn. Am., Reg. Prof. Engr. (11 states).

HAGEN, E. Bruce (3): Commissioner, North Dakota Public Service Commission, Bismarck, ND 1961-, Deputy Motor Vehicle Registrar for North Dakota 1961. Farmer in Benson and Ramsey Counties in North Dakota 1956-. Mem. Mid-America Regulatory Comm., Natl. Assn. Reg. Util. Comm., Regional Energy Adv. Bd. of U.S. Dept. of Energy, Regulatory Council.

HALLINGER, Donald E. (8): Mgr. Expl., Pacific Lighting Gas Development Co., Los Angeles, CA 1977-; Sr. Geol. 1966-77. Mem. Am. Assn. Petrol. Geol. (Cert.), Assn. Prof. Geol. Scientists (Cert., Past Sec.-Treas.), Soc. Econ. Paleon. & Min.

HANLEY, John M. (7): Retired, Omaha, NB 1973-. Northern Nat. Gas Co., V. Pres.-Gas Supply Studies 1965-73; V. Pres.-Long Range Planning 1963-65; V. Pres.-Gas Supply 1950-63; Supt. Prod./Head Dept. 1942-50; Prod. Engr. 1936-42; Gas Field Supt. (KS) 1933-36. Mem. Am.

Assn. Petrol. Geol., Soc. Petrol. Engr., Am. Gas Assn. (Nat. Gas Reserves Comm. 1945-56; Chmn., Nat. Gas Prod. Comm. 1956), Natl. Petrol. Council (Comm. on U.S. Energy Outlook 1970-72), Fed. Power Comm. (Natl. Gas Surv., Gas Supply Task Force 1970-73), Adv. Comm. on Energy to Sec. Int. 1970-71. (Honorary Technical Advisor.)

HAUN, John D. (8): Prof. Petrol. Geol., Colorado School of Mines, Golden, CO 1955-. Barlow and Haun, Inc., Consultant 1957-. Petroleum Research Corp., V. Pres. 1952-57. Stanolind (Amoco), Geol. Party Ch. 1951-52. Mem. Am. Assn. Petrol. Geol. (Pres. 1979-80), Am. Geol. Inst. (V. Pres. 1980-81, Pres. 1981-82), Am. Inst. Prof. Geol. (Pres. 1976), Am. Petrol. Inst., Geochem. Soc., Geol. Soc. Am. (Fellow), Nat. Petrol. Council, Rocky Mtn. Assn. Geol. (Pres. 1968), Soc. Econ. Paleon. & Min., Commissioner, Colorado Oil and Gas Conservation Comm. 1977-.

HERRINGTON, J.C. (7): Mgr., Geol. Staff, ARCO Exploration Co., Dallas, TX 1981-; Mgr., Atlantic OCS Proj., Mgr., CO^2 Expl., Western Reg. 1978-80; Mgr. Expl. Permian Dist. (Midland, TX) 1973-78; Spec. Proj. & Dist. Geol. (Lafayette, LA) 1971-73; Dist. Geol. (Tyler, TX) 1962-71; Dist. Geol. (offshore LA) 1959-62; Area Geol. (Dallas, TX) 1959; Geol. & Sr. Geol. (So. LA) 1953-58; Oil Scout (MS-AL) 1952-53. Mem. Am. Assn. Petrol. Geol., W. TX Geol. Soc., Am. Gas Assn., Am. Petrol. Inst., NM Geol. Soc., Assn. Prof. Geol. Scientists, Dallas Geol. Soc., Rocky Mtn. Assn. Geol.

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KALISCH, Robert B. (4): Director, Gas Supply and Statistics, American Gas Association, Arlington, VA 1975-. U.S. Air Force assignments (including Off. Scientific Research, Science and Tech. Staff Officer and Dir., Ionospheric Physics Lab.) 1951-75. Mem. Inst. Elec. and Electronics Engr., Research Soc. Am., Prof. Engr. (MA).

KENT, Harry C. (4): Director, Potential Gas Agency, Colorado School of Mines, Golden, CO 1976-; Prof. Geol. 1969-, Head Geol. Dept. 1970-75, Act. Head, Geol. Dept. 1969-70, Assoc. Prof. Geol. 1967-69, Asst. Prof. Geol. 1964-67, Instructor Geol. 1956-64. The California Co., Geologist (FL & LA) 1953-56. Stanford Univ., Teaching Asst. 1953. Mem. Am. Assn. Petrol. Geol. (Cert. Petrol. Geol. #2485), Geol. Soc. Am. (Fellow), Rocky Mtn. Assn. Geol. (Ed., Colorado Geology 1978-80), Soc. Econ. Paleon. & Min.

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MOUNCE, Paul (8): Expl. Mgr., Petrosil Resources Inc., Dallas, TX 1980-. Ind. Petrol. Geol. 1978-80. Maynard Oil Co., Ch. Geol. 1974-78. Lone Star Gas Co., Staff & Corporate Development. Texas Pacific Oil Co., Dist. Geol. Fifteen Oil Co., Dist. Geol. Warren Petrol. Corp., Dist. Geol. Mem. Am. Assn. Petrol. Geol., Am. Inst. Min., Met. & Petrol. Engr.

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PLATT, Jeremy (1): Proj. Mgr. Energy Res. Program, Electric Power Research Inst., Palo Alto, CA 1974-. Mem. Am. Assn. Petrol. Geol. (Energy Min. Div., Comm. on Nuclear Minerals), Geol. Soc. Am.

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TERRY, Lyon F. (9): Ret., Ridgewood, NJ 1967-. Lehman Bros., Assoc. 1957-66; Chase Nat. Bank, V. Pres. & Gas Engr. 1937-57; Ralph E. Davis Engr. (NYC), V. Pres. 1927-37; ESSO (NJ), Gas Eval. Engr. 1925-27; O&G Engr. (OK) 1915-25. Mem. Soc. Petrol. Engr., Am. Gas Assn. (Nat. Gas Reserves Comm., organized and Chmn. 1944). (PGC organizer, first Chmn., Honorary Technical Advisor.) (Deceased.)

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AREA A

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RAGSDALE, Tom R., (4): Sterling Drilling & Prod. Co., Inc., Charleston, WV 1981-. Ray Resources, Ch. Geol. 1973-81. Consolidated Gas Supply Corp., Devel. Geol. (Clarkburg, VA) 1966-73. McCullough Tool Co., Engr. Geol. 1962-66. Mem. Appalachian Geol. Soc. (Past V. Pres.).

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WIGAL, James M. (3): Dist. Expl. Mgr., Adobe Oil & Gas Corp., Pittsburgh, PA 1981-. Peoples Nat. Gas Co., Geol./Geophys./Explor. Mgr. 1975-81. Dept. of Energy/Bureau of Mines (Morgantown, WV) Geol. 1974-75. Mem. Am. Assn. Petrol. Geol., Soc. Econ. Paleon. & Min., Soc. Econ. Geol., SPWLA.

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BOWEN, David G. (3): Oper. Mgr., Ansythe Exploration Co., New Orleans, LA 1981-. Eason Oil Co., Dist. Explor. Mgr. 1978-81. Florida Gas Exploration Co., Div. Prod. Geol. 1969-78. Chevron U.S.A., Explor. Geol. 1967-69; Geophys. 1965-67; Dev. Geol. 1961-65; Expl. Geol. (Billings, MT) 1959-61. United Fuel Gas Co. (Charleston, WV), Geol. 1955-57. Mem. Am. Assn. Petrol. Geol., New Orleans Geol. Soc.

COOK, Billy C. (4): Chief Geol., Holly Energy, Inc., New Orleans, LA 1981-. The Louisiana Land and Exploration Co. (New Orleans, LA) Geol. 1972-81. Chevron Oil Co., Dev. & Expl. Geol. 1967-72. Mem. Am. Assn. Petrol. Geol., MS Geol. Soc., New Orleans Geol. Soc., Soc. Econ. Paleon & Min.

RICHART, John M. (4): Dist. Expl. Geol., Union Oil Co. of CA, Jackson, MS 1975-. Pure Oil Co. (prior to merger with Union), Expl. Geol. (IL, MI and Appalachian Basins) 1969-75. Mem. Am. Assn. Petrol. Geol., Jackson Geophysical Soc., MS Geol. Soc.

SPOONER, Harry (4): Gen. Partner, Spooner Petrol. Co., Jackson, MS 1976-. Pruet & Hughes, Consulting Geol. 1971-76. Cons. and Ind. Geol. (Monroe, LA) 1963-71. CO O&G Corp., Dist. Geol. (SE U.S.) 1957-63. CA Co., Dev. Geol. 1955-57. Mem. Am. Assn. Petrol. Geol. (CPG #329), MS Geol. Soc.

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AREA D

Billy D. Brown, Chairman

ANDERSON, Sherman (1): Ch. Geol., Moore McCormack Energy, Dallas, TX 1981-; Eastern Dist. Expl. Mgr. 1979-81. Jackson Exploration (Dallas, TX), Dist. Geol. 1979. Lear Petroleum (Dallas, TX), Area Geol. 1978-79. Universal Resources (Dallas, TX), Dist. Geol. 1978. Ensearch Exploration (Tyler, TX, Jackson, MS, Dallas, TX), Sr. Staff Geol., Dist. Geol., Geol. 1964-78. Diamond Shamrock (Amarillo, TX), Jr. Geol., Geol. 1955-64. Mem. Am. Assn. Petrol. Geol.

BROWN, Billy D. (2): Mgr., Gas Res. Engr. Dept., Lone Star Gas Co., Dallas, TX 1982-; Sr. Staff Petrol. Engr. 1974-82. Eppler, Guerin & Turner, Acct. Exec. 1967-74. Cornell Oil Co., Petrol. Engr. 1966-67. Texas Pacific Oil Co., Staff Petrol. Engr. 1962-66. Texas Pacific Coal & Oil Co., Petrol. Engr. 1953-62. Mem. Nat. Gas Soc. No. TX, Soc. Petrol. Engrs. of Am. Inst. Min., Met. & Petrol. Engr.

**BOYINGTON, Lowell D. (3): Prod. Engr., Arkansas Western Gas Co., Fayetteville, AR 1967-. Texaco Inc., Area Engr. (Kermit, TX) 1962-67. Mem. Reg. Petrol. Engr. AR, Soc. of Petrol. Engrs., Am. Inst. Min., Met. & Petrol. Engr.

BURGESS, Ferrell L. (8): Dist. Mgr., Pennzoil Prod. Co., Shreveport, LA 1980-; Domestic Region Exploitations Mgr. (Houston) 1978-80; Sr. Geol. 1975-78; Dist. Res. Dev. Mgr. 1970-74; Geol. 1967-69. Union Prod. Co., Geol. 1955-67. Mem. Am. Assn. Petrol. Geol., Am. Petrol. Inst., Shreveport Geol. Soc.

FEEMSTER, Lee T. Jr. (8): Geol. Consultant, Abilene, TX 1974-. Texas Pacific Oil Co., Expl. Geol. & Development Geol. 1955-74. Stanolind (Amoco), Expl. Geol. 1951-55. Mem. Am. Assn. Petrol. Geol., Abilene Geol. Soc., West Texas Geol. Soc.

GEARHART, Harry L. (1): Independent, Dallas, TX 1977-. Maynard Oil Co., V. Pres. Expl. (Dallas, TX) 1972-77. Lone Star Prod. Co., Dist. Geol. (Dallas, TX) 1970-72; Dist. Geol. (Tyler, TX) 1967-70; Geol. 1961-67; Geol. (Shreveport, LA) 1958-61. Mem. Am. Assn. Petrol. Geol., East TX Geol. Soc.

MOUNCE, Paul (8): Expl. Mgr., Petrosil Resources Inc., Dallas, TX 1980-. Ind. Petrol. Geol. 1978-80. Maynard Oil Co., Ch. Geol. 1974-78. Lone Star Gas Co., Staff & Corporate Development. Texas Pacific Oil Co., Dist. Geol. Fifteen Oil Co., Dist. Geol. Warren Petrol. Corp., Dist. Geol. Mem. Am. Assn. Petrol. Geol., Am. Inst. Min., Met. & Petrol. Engr.

*SPENCER, Walter E. (4): The Coastal Corp., Houston, TX.

AREA E

Charles R. Brammell, Chairman
John H. McElroy, Vice Chairman

BRAMMELL, Charles R. (3): V. Pres. Development, Graham Energy, Metairie, LA 1981-; Consulting Devel. Geol. 1980-81. CNG Producing Co. (New Orleans, LA), Mgr. Development 1980; Chief Devel. Geol. 1977-80; Devel. Geol. 1973-77. Gulf Oil Corp., Expl. & Devel. Geol. 1960-73 and 1957-58. Sinclair Oil & Gas, Expl. & Devel. Geol. 1959-60. Hycalog, Mudlogging Engr. 1958-59. Mem. New Orleans Geol. Soc.

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LOWE, James T. (1): Area Expl. Geol., Union Oil Co. of California, Lafayette, LA 1976-. Mem. Am. Assn. Petrol. Geol.

*MAINARD, A. D. (1): Mgr. Reserves Dept., Tennessee Gas Pipeline Co., Houston, TX 1972-; Supv. Geol., Sr. Geol., Geol. 1953-72. Lone Star Producing Co. (Dallas, TX) Prod. Engr. 1949-53. Mem. Am. Assn. Petrol. Geol., Prof. Engr. TX, Soc. Petrol. Engrs.

McELROY, John H. (2): Sr. Coord., Expl. & Prod. Serv., Texaco Inc., Bellaire, TX 1977-; Expl. Coord. 1972-77; Midland Asst. Div. Mgr. 1969-72; Houston Div. Geol. 1967-69; Houston Asst. Div. Geol. 1961-67; Geol. 1958-61. Seaboard Oil Co., Geol., Asst. Dist. and Dist. Geol. 1951-58. Gulf Oil Corp., Surf. and Subsurf. Geol. 1948-51. Mem. Am. Assn. Petrol. Geol.

RASSINIER, E. A. (9): Independent, Houston, TX 1981-. Trunkline Gas Co., Dir. Resource Planning 1964-81; Ch. Petrol. Engr. 1953-64. Phillips Petrol. Co. (Prod. Dept.), Supv. Petrol. Engr. (Bartlesville, OK) 1951-52, Reg. Reservoir Engr. (Houston) 1947-50; Div. Reservoir Engr. (Oklahoma City) 1946; Petrol. Engr. (Bartlesville, Borger, Kansas City) 1942-43. Mem. Am. Assn. Petrol. Geol., Am. Inst. Min., Met. & Petrol. Engr., Soc. Petrol. Engrs., Houston Engr. & Scientific Soc., Houston Geol. Soc., Gas Res. Inst. Indus. Tech. Adv. Comm. (Unconventional Nat. Gas), Reg. Prof. Engr. (TX & MO). (Honorary Technical Advisor.)

RIEKER, James D. Jr. (2): V. Pres., Develop./Engineering, Texas Gas Exploration Corporation, Houston, TX 1981-; Mgr., Petrol. Engineering 1980-81; Reservoir Engr. & Sr. Reservoir Engr. 1976-80. Amoco Production Co. (Houston, TX), Oper. Engr. & Reservoir Engr. 1974-76; Prod. Engr. 1973-74. Mem. Am. Petrol. Inst., Soc. Petrol. Engrs. of Am. Inst. Min., Met. & Petrol. Engr., TX Mid-Continent Oil & Gas Assn.

**ROCHESTER, David A. (5): Asst. Mgr., Gas Supply, Public Service Elec. & Gas Co., Newark, NJ 1981-; Fuels Planning Engr. 1977-81; Nat. Gas Engr. 1971-77; Engr. 1967-71; Cadet Engr. 1966-67. River Gas Co., Engr. (Marietta, OH) 1964-66. Mem. Am. Gas Assn. (Task Force), Am. Inst. Min., Met. & Petrol. Engr., Assoc. Gas Dist. (Chmn. Operating Comm.), NJ Gas Assn. (Supply & Rates Comm.), Petrol. Expl. Soc. NY, Soc. Petrol. Engrs.

SEAL, Warren L. (2): V. Pres./Division Manager, Florida Exploration Co., New Orleans, LA 1978-. Exchange Oil & Gas Corp., Ch. Geol. 1972-78. Amoco Prod. Co., Ch. Geol. (New Orleans and Houston) 1967-72. Mem. Am. Assn. Petrol. Geol., New Orleans Geol. Soc.

AREA G

John C. Kucewicz, Jr., Chairman
Bill C. Burkman, Vice Chairman

BURKMAN, Bill C. (4): V. Pres., Exploration, States Petroleum Inc., Houston, TX 1982-. Consultant 1980-82. Santa Fe Energy, Reg. Mgr. 1969-79. Nat. Gas Pipeline Co., Dist. Geol. 1957-69. Geophysical Exploration, Party Chief 1951-57. Univ. Nebraska, Geol. 1951. Mem. Am. Assn. Petrol. Geol., Soc. Econ. Geol., Houston Geol. Soc.

HORSTMANN, Lane E. (3): Geol. Consultant & Ind. Prospect Generator, Houston, TX 1977-. Lone Star Prod. Co. (Enserch Expl.) (Midland, Abilene, San Antonio and Houston, TX), Expl. Mgr., Dist. Geol., and Geol. 1951-77. Mem. Am. Assn. Petrol. Geol., Houston Geol. Soc., Soc. Prof. Earth Scientists.

KUCEWICZ, John C. Jr. (1): Geol. Specialist (Dev. Geol.), CNG Producing Co., McAllen, TX 1981-; Geol. Specialist (New Orleans, LA) 1978-81. Texaco Inc. (New Orleans, LA), Geol. Asst. 1975-78. Mem. Am. Assn. Petrol. Geol., Corpus Christi Geol. Soc., New Orleans Geol. Soc. (past chmn.; Scouting Comm. 1978-81).

*MORRIS, Jeffery V. (5): Manager, Res. Geol., Transcontinental Gas Pipeline Corp., Houston, TX; Reg. Geol., Dist. Geol., Sr. Geol., Geol. 1961-. Sun Oil Co., Geol. (Houston) 1959-61. El Paso Nat. Gas Co., Geol. (New Orleans) 1956-59. Gulf Oil Corp., Geol. (New Orleans) 1954. Mem. Am. Assn. Petrol. Geol., Houston Geol. Soc. (Pres. 1978-79), Natural Gas Men of Houston.

SNIDER, Irving L. (1): V. Pres., Expl. & Prod., Total Petroleum, Inc., Houston, TX 1980-. Newmont Oil Co. (Houston, TX), V. Pres., Expl. 1969-80. Various independent and small companies 1964-69. Atlantic Refining Co., various positions, 1948-64. Mem. Am. Assn. Petrol. Geol., Houston Geol. Soc.

**SULLIVAN, Richard A. (7): Pres., So. County Gas and Bristol & Warren Gas Co., Hingham, MA 1959-. Boston Transit System, Exec. & Consulting Eng. 1949-58. Detroit Transit System, Gen. Manager 1945-48. City of Detroit, Public Util. Anal. 1942-45. U.S. Engr., Consulting Engr. 1941-42. MA Dept. Public Util., Elec. Engr. 1937-41. Mem. Am. Gas Assn., NE Gas Assn., Harvard Engr. Soc., MA Soc. Prof. Engr., NH Bar Assn.

AREA H

D. Keith Murray, Chairman
C. Keith Fisher, Vice Chairman

BARLOW, James A. Jr. (4): V. Pres., Barlow & Haun, Inc., Casper, WY 1957-. Forest Oil Corp., Geol. 1953-57. Ohio Oil Co., Geol. 1952-53. Mem. Am. Assn. Petrol. Geol., Assn. Prof. Geol. Scientists, Geol. Soc. Am., Rocky Mtn. Assn. Geol., WY Geol. Assn., Ind. Petrol. Assn. Mtn. States.

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CROWLEY, Charles J. (5): Consulting Reservoir Geol., El Paso Natural Gas Co., El Paso, TX 1977-; Sr. Reservoir Geol. 1965-77. Hercules Powder Co., Supv. 1962-65. Consultant (WY & AZ) 1958-62. Forest Oil Corp., Area Geol. 1953-59. Marathon Oil Co. (OH Oil), Scout-Area Geol. (Billings and Casper) 1949-53. Mem. Am. Assn. Petrol. Geol., El Paso Geol. Soc., Soc. Mining Engr., Reg. Geol. (AZ).

DIEHL, Laurence A. (1): Expl. Mgr., Century Oil and Gas Corp., Englewood, CO 1981-. Cities Service Co. (Billings, MT, Casper, WY, Denver, CO), Expl. positions 1953-81. Mem. Rocky Mtn. Assn. Geol., KS Geol. Soc., WY Geol. Soc.

FISHER, C. Keith (3): Consulting Geol., Denver, CO 1981-. Panhandle Eastern Pipe Line Co. (Denver, CO), Reg. Geol. 1977-81. U.S. Geological Survey (Denver), Geol. 1974-77. Ind. Geol. (Denver) 1973-74. American Stratigraphic Co., Gen. Mgr., Vice Pres. (Denver) 1961-73; Manager (Billings & Casper) 1955-61. Canadian Stratigraphic Serv., Ltd., Geol. (Calgary) 1952-55. Panhandle Eastern Pipe Line, Geol. (Liberal, KS) 1949-52. Mem. Am. Assn. Petrol. Geol., Am. Inst. Prof. Geol., Rocky Mtn. Assn. Geol., WY Geol. Assn., MT Geol. Soc.

GERHARD, Lee C. (1): Prof. Geol., Colorado School of Mines, Golden, CO and Assoc. Dir., Potential Gas Agency and Consultant, Gerhard and Associates 1982-. Supron Energy Corp. (Englewood, CO), Expl. Mgr. 1981-82. ND Geol. Survey, State Geol. & Dir. 1977-81; Asst. State Geol. 1975-77. Univ. ND, Chmn. and Prof. Geol. 1977-81; Assoc. Prof. Geol. 1975-77. West Indies Lab. and Fairleigh Dickinson Univ., Act. Dir. and Assoc. Prof. Geol. 1975; Asst. Dir. and Assoc. Prof. 1972-75. Univ. So. CO, Assoc. Prof. Geol. 1966-72. Sinclair Oil and Gas Co., Reg. Stratigrapher 1965-66; Expl. Geol. 1964-65. Amerada Petrol. Corp., Party Chief 1962. Univ. KS, Inst. Geol., Asst. Inst. Geol., Teaching Fellow 1960-64. Mem. Am. Assn. Petrol. Geol., Am. Inst. Prof. Geol., Assn. Am. State Geol., CO Scient. Soc., Geol. Soc. Am., ND Geol. Soc., Rocky Mtn. Assn. Geol., Soc. Econ. Paleon. & Min.

HABBIT, Robert D. (5): Mgr. Reservoir Engineering, El Paso Natural Gas Co., El Paso, TX 1978-; Mgr. Reservoir Studies 1978; Cons. Reservoir Geol. 1977-78; Staff Geol. 1966-77. Ind. Geol. (Houston) 1965-66. El Paso Natural Gas Co., Sr. Reservoir Geol. (Houston) 1957-65. Sohio Petroleum Co., Geophysicist/Geol. (Gulf Coast-Rky. Mtns.) 1954-57. Mem. Am. Assn. Petrol. Geol. (CPG. #166), Am. Inst. Prof. Geol. (Cert. #2489), Am. Inst. Min., Met. & Petrol. Engr., Soc. Expl. Geophysicist, Rocky Mtn. Assn. Geol., El Paso Geol. Soc.

HAWK, David H. (4): Sr. V. Pres., Horn Resources Corp., Boise, ID 1981-. Sundance Oil Co. (Denver, CO), V. Pres. Expl. 1980-81. IGC Production Co., V. Pres. & Gen. Mgr. and Intermountain Gas Co. (Boise, ID), Mgr. Expl. & Prod. 1977-80; Nat. Res. Advisor 1973-76. Tenneco Oil Co., Expl. Geol. (Denver) 1972-73. Atlantic Richfield, Expl. Geol. (Dallas, TX & Lafayette, LA) 1970-72. Mem. Am. Assn. Petrol. Geol. (Energy Minerals Div.), ID Assn. Prof. Geol., Geol. Soc. Am., Rocky Mtn. Assn. Geol., Geothermal Resource Council, Am. Gas Assn.

KIDWAI, Moid (4): Staff Res. Engr., Northern Natural Gas Co., Denver, CO 1981-; Sr. Res. Engr. (Denver, CO and Omaha, NB) 1978-80; Res. Engr. 1975-77. Metro Subway, Geol. (Washington, DC) 1974-75. Oil & Gas Development Corp., Petrol. Engr. (Pakistan) 1968-72. Mem. Am. Assn. Petrol. Geol., Soc. Petrol. Engr.

McPEEK, L. A. (2): Consulting Geol., Denver, CO 1972-. Koch Exploration, Expl. Mgr. Rocky Mtn. Div. (Denver, CO) 1969-72. Pan American Petroleum (Amoco), Dist. Oper. Geol. (Denver, CO and New Orleans, LA) 1962-69. Mem. Am. Assn. Petrol. Geol., Rocky Mtn. Assn. Geol., WY Geol. Assn.

MOTSCH, A. Sherrill (2): Dist. Devel. Geol., Marathon Oil Co. (formerly The Ohio Oil Co.), Casper, WY 1979-; Devel. Geol. 1967-79; on staff of Div. Geol. & Div. Expl. Mgr. 1957-66; Field & Devel. Geol. (Cody, WY) 1953-57; Field Geol. (Rawlins, WY) 1951-53. Mem. WY Geol. Assn.

MURRAY, D. Keith (8): Mgr. Spec. Proj., Energetics, Inc., Englewood, CO 1981-. Colorado Sch. Mines Research Inst. (Golden, CO) 1979-81. CO Geol. Surv. (Denver, CO) 1973-79. Coronado Oil Co., Cons. Geol. (Denver) 1969-73. Sinclair Oil Corp. (Denver) 1966-69. Cons. Geol. (Denver) 1962-66. Clark Oil & Refining Corp. (Denver) 1960-62. Ind. Geol. (Los Angeles) 1959-60. Manabi Expl. Co. (Ecuador, SA) 1956-58. Shell Oil Co. (CA, UT, NV, LA) 1953-56. Mem. Am. Assn. Petrol. Geol. (Rocky Mtn. Sec. Councillor, Energy Min. Div., Mem. House of Delegates, Natl. AAPG V. Pres. 1979-80), Am. Inst. Prof. Geol., CO Sci. Soc., Denver Coal Club, Geol. Soc. Am., Rocky Mtn. Coal Min. Inst., Rocky Mtn. Petrol. Pioneers, WY Geol. Assn.

POWERS, Richard B. (3): Geol., U.S. Geological Survey, Br. Oil & Gas, Lakewood, CO 1974-. Consultant (Denver) 1971-74. Bolyard & Assoc., V. Pres. (Denver) 1968-71. Tenneco Oil, Sr. Staff Geol. (Houston) 1967-68; Dist. Geol. (Casper) 1965-67; Dist. Mgr. (Pittsburgh) 1962-65; Reg. Geol. (Casper & Denver) 1959-62. Petrobras, Geol. (Belem, Brazil) 1958-59. Pure (Union) Oil Co., Geol. (Grand Junction, CO) 1952-58. Mem. Am. Assn. Petrol. Geol. (Membership Committee), Rocky Mtn. Assn. Geol., WY Geol. Assn., Canadian Soc. Petrol. Geol.

SANBORN, Albert F. (3): Expl. Mgr., Frontier Div., Buckhorn Petroleum Co., Denver, CO 1981-. Cons. Geol. (Denver, CO) 1978-80. Chevron U.S.A., Sr. Geol. (Denver) 1963-78; Div. Stratigrapher (Salt Lake City) 1959-63; Dist. Stratigrapher 1955-59; Geol.-Stratigrapher 1954-55; Geol.-Stratigrapher (Los Angeles) 1952-54. Mem. Am. Assn. Petrol. Geol., Assn. Ind. Petrol. Geol., Rocky Mtn. Assn. Geol.

*STRACKE, Kenneth J. (4): Director, Northwest Pipeline Corp., Salt Lake City, UT 1975-. Consultant (Salinas, CA) 1974-75. Union Oil Co. of CA, Dist. Mgr. (Santa Rosa, CA) 1972-74; Dist. Oper. Mgr. (Orcutt, CA) 1969-72; Dist. Prod. Supt. 1968-69; Dist. Engr. 1968; Engr. Supv. (Coalin-

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ga, CA) 1962-68; Petrol. Engr. (San Joaquin Valley, CA) 1954-62. Mem. Am. Gas Assn. (Expl. & Prod. Comm.), Reg. Prof. Engr. UT, Soc. Petrol. Engr. of Am. Inst. Min., Met. & Petrol. Engr. (Chmn. San Joaquin Valley, CA Sec. 1962).

TONNSEN, John J. (1): V. Pres. Expl., General Hydrocarbons, Inc., Billings, MT 1981-. The Montana Power Company, Sr. Expl. Geol. (Billings, MT) 1975-81. Shell Oil Co., Gen. Expl. Attorney (New York and Denver) 1967-73. Pan American Petroleum Co., Expl. Field Geol. (MT, ID, CO, and UT) 1960-62. Mem. Am. Assn. Petrol. Geol., MT Geol. Soc., MT & CO State Bar Assn., Fed. Energy Bar Assn.

WOODBURY, H. O. (1): Div. Geol. Rocky Mtn. Div., Chevron U.S.A. Inc., Denver, CO 1981-. Standard Oil Co. of California, Indonesia 1979-81; New Orleans, LA 1972-81; Tripoli, Libya 1971-72; New Orleans, LA 1965-71; Chevron Research Corp., La Habra, CA 1964; New Orleans, LA 1955-64; Casper, WY and Denver, CO 1946-55. Mem. Am. Assn. Petrol. Geol. (Cert.), Rocky Mtn. Assn. Geol.

AREA I

Robert D. Habbit, Chairman
Edward M. Allshouse, Vice Chairman

ALLSHOUSE, Edward M. (3): Sr. Reservoir Geol., El Paso Natural Gas Co., El Paso, TX 1973-. Mem. Am. Assn. Petrol. Geol. (SW Sect. Delegate), Am. Inst. Min., Met. & Petrol. Engr. (V. Chmn. El Paso Chapter), El Paso Geol. Soc. (Sec.-Treas.).

DAVIES, David J. (3): Geol., Expl. and Dev., Southern Union Exploration Co. (SX), Dallas, TX 1977-82. Enserch Exploration, Inc. (Lone Star Producing Co.), Geol. (Dallas) 1975-77. Mem. Am. Assn. Petrol. Geol., Soc. Econ. Paleon. and Min., Dallas Geol. Soc.

**GASS, Bernie (3): Mgr., Fuel Supply, AZ Pub. Serv. Co., Phoenix, AZ 1973-82; Mgr. System Gas Constr. 1972; Consultant, New Bus. Develop. 1969-71; Engr., Power Prod. 1966-68; Engr., Gas Engineering 1961-65. Mem. Am. Soc. Mech. Engrs., Pacific Coast Gas Assn.

HABBIT, Robert D. (5): Mgr. Reservoir Engineering, El Paso Natural Gas Co., El Paso, TX 1978-; Mgr. Reservoir Studies 1978; Cons. Reservoir Geol. 1977-78; Staff Geol. 1966-77. Ind. Geol. (Houston) 1965-66. El Paso Natural Gas Co., Sr. Reservoir Geol. (Houston) 1957-65. Sohio Petroleum Co., Geophysicist/Geol. (Gulf Coast-Rky. Mtns.) 1954-57. Mem. Am. Assn. Petrol. Geol. (CPG #166), Am. Inst. Prof. Geol. (Cert. #2489), Am. Inst. Min., Met. & Petrol. Engr., Soc. Expl. Geophysicists, Rocky Mtn. Assn. Geol., El Paso Geol. Soc.

KOTTLOWSKI, Frank E. (3): Dir. & Sr. Geol., NM Bureau of Mines & Mineral Resources, Socorro, NM 1974-; Assoc. Dir., Sr. Geol., Econ. Geol. 1951-74. Indiana Geol. Surv., Party Chief, Coal Div. 1947-51. Indiana Univ. Geol. Dept., Inst. 1950-51. Mem. Am. Assn. Petrol. Geol. (Editor 1971-75), Geol. Soc. Am. (Fellow), Soc. Econ. Geol., Assn. Am. State Geol., Soc. Econ. Paleon. & Min., Assn. Prof. Geol. Scientists (Past Pres. NM section), Am. Assn. Adv. Science (Fellow).

MARTIN, Gregory W. (1): Sr. Geol., Wexpro Co., Farmington, NM 1981-; Geol. 1980-81; Assoc. Geol. 1979-80. Texaco Inc. (Houston, TX), Adv. Geol. and Proj. Geol. 1979; Dev. Geol. 1977-79; Expl. Geol. 1976-77; Geophys. Processor 1975-76. Mem. Am. Assn. Petrol. Geol., Four Corners Geol. Soc.

*VAUGHAN, W. L. (4): Gen. Mgr. Reserves Evaluation Dept., Texas Eastern and Transwestern Pipelines, Houston, TX 1973-. Texas Eastern Trans. Corp., Asst. Mgr., Reserves and Deliverability 1972-73, Jr. Petrol. Engr.-Engr. (Gas Supply Dept.) 1957-72. Mem. Am. Gas Assn. (Chmn., Underground Gas Storage Comm.), Soc. Petrol. Engr., Nat. Gas Men Permian Basin.

AREA J-N

Alan F. Chatfield, Chairman
Joe E. McGarrah, Vice Chairman

CHATFIELD, Alan F. (4): Expl. Mgr., Berry Petroleum Corp., Oklahoma City, OK 1982-. Chatfield Petroleum Corp., Pres. (Oklahoma) 1981-82; Berry Petroleum Corp., Chief Geol. 1980-81. L. R. French, Jr., Expl. Mgr. 1980. GHK Corp., Expl. Mgr. 1976-80. Carlsberg Petroleum Corp., Sr. Staff Explor. (International & CA) 1974-76. Oceanic Exploration Co., Geophys. and Local Overseas Mgr. (International and CO) 1973-74. Conoco, Geophys. (International and OK) 1972-73. GHK Corp., Geophys. (TX and OK) 1971. Humble Oil & Refining Co., Geophys. (TX and OK) 1967-71. Mem. Am. Assn. Petrol. Geol., Soc. Expl. Geophy., OKC Geol. Soc., Geophy. Soc. OKC.

*KNOBLOCH, Mike H. (1): Mgr. Prosp. Eval., Panhandle Eastern Pipe Line Co., Kansas City, MO 1981-; Asst. Chief Res. Engr. 1976-81; Res. Engr. (Liberal, KS) 1971-76. Mobil Oil Corp., Field Engr. (Countyline, OK) 1969. Mem. Am. Gas Assn. (Reserves Subcommittee), Soc. Petrol. Engrs.

**McGARRAH, Joe E. (4): Chief Geol., ONEOK Exploration Co., Tulsa, OK 1981-; Sr. Geol. 1978-81; Staff Geol. 1973-78. National Assn. Petrol. Co., Reg. Geol. 1956-73. Frost Geophysical Co., Geophysics Training 1954-56. U.S. Air Force Intelligence, Photo Interpreter 1952-54. U.S. Geol. Surv., Topographic Engr. (Rolla, MO) 1951-52. Mem. Am. Assn. Petrol. Geol., Gas Men's Assn. OK, Tulsa Geol. Soc.

WILSON, Gary (1): Northern Natural Gas Co., Tulsa, OK.

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AREA J-S

Louis F. Marczynski, Chairman
C. K. McLaughlin, Vice Chairman

GAINES, Robert B. (2): Res. Engr., Nortex Oil & Gas Co., Midland, TX 1981-; Northern Natural Gas Co. (Nortex), Expl. Geol. 1970-81; Res. Engr. (Omaha, NB) 1956-70. So. California Petroleum, Expl. Geol. (Midland, TX) 1955-56. Ohio Oil Co. (Marathon), Expl. Geol. (Midland, TX) 1951-55. Mem. Am. Assn. Petrol. Geol., Am. Inst. Min., Met. & Petrol. Engr., Am. Inst. Prof. Geol., Soc. Econ. Paleon. & Min., West TX Geol. Soc., Reg. Prof. Engr. TX.

MARCZYNSKI, Louis F. (1): Exploitation Engr. Spec., Superior Oil Co., Midland, TX 1982-. Northern Natural Gas Co. (Internorth), Reg. Mgr. Res. Eval. (Midland, TX) 1978-82; sixteen years experience in various engineering positions 1966-82. Mem. Am. Gas Assn., Nat. Gas Soc. of Permian Basin, Soc. Petrol Engr. (AIME).

*McLAUGHLIN, C. K. (1): Reg. Mgr. Sup. Eval. & Reserve Mgmt. Permian Basin, Northern Natural Gas Co., Midland, TX 1980-. ANR Production Co., Staff Res. Engr. (Houston, TX) 1978-80. Forest Oil Co., Div. Res. Engr. (Midland, TX) 1960-78. H. S. Cole, Resident Mgr. (Santa Domingo, Dom. Rep.) 1958-60. Amoco, Dist. Res. Engr. (Denver, CO) 1951-58. Mem. Nat. Gas Soc., Soc. Petrol. Engr., TX Prof. Engr.

**PERKINS, Kenneth R. (1): Sr. Gas Contracts Rep., Westmar Trans. Co., Amarillo, TX.

AREA K

Alexander Sisson, Chairman

CLARDY, Bruce (1): Expl. Supv., Expl. Oper. No. Alaska & Beaufort Sea, Sohio Alaska Petroleum Co., Anchorage, AK 1980-. Louisiana Land & Expl. Co. (Denver, CO) 1975-80. Union Oil Co. of CA (Grand Junction, CO) 1974-75; (Anchorage AK) 1968-74; (Santa Maria, CA) 1967-68. Mem. AK Geol. Soc., Am. Assn. Petrol. Geol. (Cert. Petrol. Geol. #2257), Geol. Soc. Am., Geoph. Soc. AK, Soc. Econ. Paleon. & Min.

HARTMAN, Donald C. (5): Expl. Land Rep., Texaco U.S.A., Anchorage, AK 1975-. AK Geol. Survey, State Geol. 1973-74; Petrol. Geol. 1971-73. Texaco U.S.A., Geol. (Anchorage, AK) 1962-71; Geol. (Los Angeles & Ventura basins) 1956-62. Mem. AK Assn. Petrol. Landmen, AK Geol. Soc., Am. Assn. Petrol. Geol., Anchorage Oil Scouts Assn., Geol. Soc. Am.

HITE, David M. (2): District Geol., ARCO Oil & Gas Co., Anchorage, AK 1979-; Sr. Staff Geol. (Dallas) 1977-79; Sr. Geol. (Anchorage) 1975-77; Sr. Research Geol. (Dallas) 1970-74; Research Geol. 1967-70. Mem. AK Geol. Soc.

LIAN, Ernest B. (5): Sr. Geol., Marathon Oil Co., Anchorage, AK 1965-; Dist. Geol. (Bakersfield) 1963-65; Geol. & Dist. Geol. (Los Angeles) 1950-63. Mem. Am. Assn. Petrol. Geol., AK Geol. Soc., Geophysical Soc. AK.

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McMULLIN, Robert H. (2): Geol., Branch of Oil & Gas Resources, U.S. Geol. Survey, Anchorage, AK 1979-; Area Geol. 1976-79; OCS Evaluation Supervisor 1975-76; Geophysicist, Conservation Div. 1971-75. Chevron U.S.A. Inc., Expl. Geol. & Geophysicist (CA, WA, OR, NV, AK) 1955-71. Mem. AK Geol. Soc., Am. Assn. Petrol. Geol., Geophy. Soc. AK, Soc. Econ. Geol.

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*Pipelines representative.

**Gas Distributors representative.

1982 ESTIMATED POTENTIAL SUPPLY OF NATURAL GAS
(Trillions of Cubic Feet)

AREA	PROBABLE	POSSIBLE	SPECULATIVE
A	27	8	49
B	7	8	35
C	< 0.5	2	1
D	8	20	19
E	27	51	< 0.5
G	23	31	4
H	49	93	66
I	2	3	1
J-NORTH	24	60	39
J-SOUTH	15	33	1
K-ALASKA	8	29	97
L	2	17	17
TOTAL UNITED STATES	192	355	329

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Plate 1

POTENTIAL GAS COMMITTEE

NATURAL GAS MAP OF THE UNITED STATES

December 31, 1982

■	AREAS OF GAS PRODUCTION INCLUDING GAS ASSOCIATED WITH OIL
▨	AREAS IN WHICH SEDIMENTARY ROCKS ARE EXPOSED AT THE SURFACE OR ARE PRESENT AT DEPTH AND COVERED AT THE SURFACE BY EXTRUSIVE IGNEOUS ROCKS
☐	AREAS IN WHICH INTRUSIVE IGNEOUS ROCKS OR METAMORPHIC ROCKS ARE EXPOSED AT THE SURFACE
╱	LIMITS OF SEDIMENTARY BASINS AS RECOGNIZED BY THE POTENTIAL GAS COMMITTEE, DASHED WHERE INFERRED
15,000	CONTOUR LINE INDICATING THICKNESS OF SEDIMENTS

25 0 25 50 75 100 125 150 175 200 MILES
25 0 25 50 75 100 125 150 175 200 KILOMETERS

Western Thrust Belt

The Western Thrust Belt, especially the central portion which is located along the Wyoming-Idaho border, has become a major target for exploration. Significant gas fields have been discovered in southwestern Wyoming and northern Utah. While the eastern boundary of this belt is fairly well defined by the limits of thrust faults, the western boundary is much more nebulous. Some interpretations extend the Western Thrust Belt southeastward from southern Nevada through Arizona, southwestern New Mexico, westernmost Texas and into Mexico. At the present time, the only areas within the Thrust Belt in which estimates of potential resources of natural gas have been made are the northern, central, and southern portions indicated on the map. Because of lack of positive confirmation of the extention of the Thrust Belt south of Utah and the lack of data on potential source rocks, reservoir rocks, and trapping mechanisms, no estimate of any potential resource of natural gas has been made for this area.

This map prepared by Terra Graphics to accompany Potential Gas Committee report, Potential Supply of Natural Gas in the United States (as of December 31, 1982). Copies available from Potential Gas Agency, Colorado School of Mines, Golden, Colorado 80401, Phone (303) 279-4320.

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Eastern Overthrust Belt

Recent exploratory activity and geophysical data have led to the interpretation of an Eastern Overthrust Belt extending from Canada southward into Georgia and Alabama. In the western portion of this belt, sedimentary rocks are exposed at the surface. In the eastern portion, sedimentary rocks are believed to exist beneath metamorphic rocks. Preliminary estimates of natural gas potential for the Eastern Overthrust Belt are included in the estimates reported for Area A.

▨	Exposed Sediments
☐	Concealed Sediments

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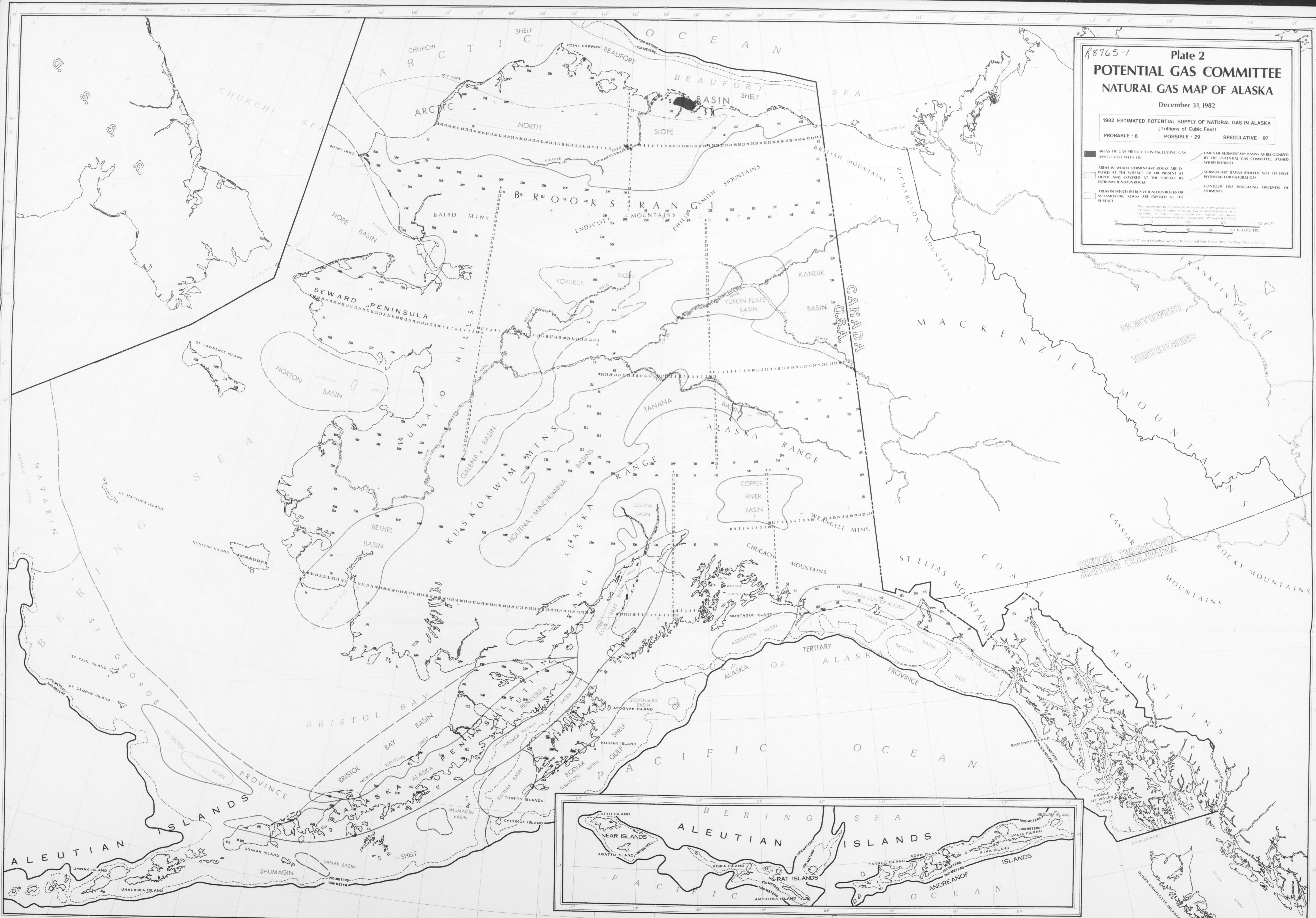

Plate 2

POTENTIAL GAS COMMITTEE

NATURAL GAS MAP OF ALASKA

December 31, 1982

1982 ESTIMATED POTENTIAL SUPPLY OF NATURAL GAS IN ALASKA
(Trillions of Cubic Feet)

PROBABLE	POSSIBLE	SPECULATIVE
8	29	97

■	AREAS OF GAS PRODUCTION INCLUDING GAS ASSOCIATED WITH OIL
☐	AREAS IN WHICH SEDIMENTARY ROCKS ARE EXPOSED AT THE SURFACE OR ARE PRESENT AT DEPTH AND COVERED AT THE SURFACE BY EXTRUSIVE IGNEOUS ROCKS
☐	AREAS IN WHICH INTRUSIVE IGNEOUS ROCKS OR METAMORPHIC ROCKS ARE EXPOSED AT THE SURFACE
―	LIMITS OF SEDIMENTARY BASINS AS RECOGNIZED BY THE POTENTIAL GAS COMMITTEE, DASHED WHERE INFERRED
-·-	SEDIMENTARY BASINS BELIEVED NOT TO HAVE POTENTIAL FOR NATURAL GAS
15000	CONTOUR LINE INDICATING THICKNESS OF SEDIMENTS

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